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STATE OF TENNESSEE  
STATE GEOLOGICAL SURVEY  
GEORGE H. ASHLEY, STATE GEOLOGIST

**BULLETIN 5**

Clay Deposits of West Tennessee

BY

WILBUR ARMISTEAD NELSON



NASHVILLE  
FOLK-KEELIN PRINTING COMPANY  
1911

## State Geological Commission.

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# CONTENTS

|                                | Page |                                 | Page |
|--------------------------------|------|---------------------------------|------|
| Introduction .....             | 1    | Tertiary System—Con.            |      |
| Geography of Area .....        | 2    | Lithological                    |      |
| Location .....                 | 2    | character .....                 | 13   |
| Topography .....               | 2    | Section .....                   | 13   |
| General character .....        | 2    | Thickness and dip ..            | 14   |
| Tennessee-Mississippi          |      | LaGrange formation ..           | 14   |
| Divide .....                   | 2    | Extent .....                    | 14   |
| Residual ridge .....           | 3    | Lithological                    |      |
| Hills of erosion .....         | 3    | character .....                 | 14   |
| The flatwoods .....            | 4    | Section .....                   | 15   |
| Alluvial region .....          | 4    | Fossils .....                   | 16   |
| Origin of Topography .....     | 4    | Thickness .....                 | 16   |
| Origin of "flatwoods" ....     | 5    | Pliocene Series .....           | 16   |
| Origin of "hills of erosion"   | 5    | Lafayette formation ..          | 16   |
| Disturbances .....             | 5    | Extent .....                    | 16   |
| General development .....      | 6    | Lithological                    |      |
| Railway facilities .....       | 6    | character .....                 | 16   |
| Character of roads .....       | 7    | Section .....                   | 17   |
| Cities and towns .....         | 7    | Thickness .....                 | 17   |
| Geology of area—Stratigraphy.. | 8    | Quaternary System .....         | 17   |
| General statement .....        | 8    | Pleistocene Series .....        | 17   |
| Formations described and       |      | Columbia formation...           | 17   |
| their description .....        | 8    | Extent .....                    | 17   |
| Paleozoic rocks .....          | 8    | Lithological                    |      |
| Cretaceous system .....        | 9    | character .....                 | 17   |
| Eutaw sand .....               | 9    | Sands .....                     | 17   |
| Extent .....                   | 9    | Loess .....                     | 17   |
| Lithological character.        | 9    | Loam .....                      | 18   |
| Section .....                  | 9    | Recent deposits .....           | 18   |
| Thickness and dip ....         | 10   | Alluvium .....                  | 18   |
| Selma clay .....               | 10   | Extent .....                    | 18   |
| Extent .....                   | 10   | Clays of the Area .....         | 18   |
| Lithological character.        | 11   | Definition of clays of area.... | 18   |
| Section .....                  | 11   | Kaolin .....                    | 18   |
| Thickness .....                | 11   | Ball clay .....                 | 19   |
| Ripley sands .....             | 11   | Sagger clay .....               | 19   |
| Extent .....                   | 11   | Wad clay .....                  | 19   |
| Lithological character .       | 11   | Potters clay .....              | 19   |
| Section .....                  | 12   | Common brick .....              | 20   |
| Thickness and dip .....        | 13   | Colors .....                    | 20   |
| Tertiary System .....          | 13   | Drainage tile clay .....        | 20   |
| Eocene Series .....            | 13   | Fire brick clay .....           | 21   |
| Porter's Creek                 |      | Mixtures of clays used in cer-  |      |
| formation .....                | 13   | tain manufactured wares ....    | 22   |
| Extent .....                   | 13   | Electrical ware .....           | 22   |

|                                  | Page |
|----------------------------------|------|
| Clays of the Area—Con.           |      |
| Porcelain and china .....        | 22   |
| White ware .....                 | 22   |
| Sanitary ware .....              | 22   |
| Stone ware .....                 | 22   |
| Character of deposits .....      | 22   |
| Embayment clays .....            | 22   |
| Deposits in fresh water ...      | 23   |
| Deposits in brackish water.      | 24   |
| Deposits under marine            |      |
| conditions .....                 | 24   |
| Glacial clays .....              | 24   |
| Lacustrine clays .....           | 25   |
| Floodplain and terrace           |      |
| clays .....                      | 25   |
| Stratigraphic position of        |      |
| deposits .....                   | 25   |
| Eutaw sands .....                | 25   |
| Selma clays .....                | 25   |
| Ripley fomation .....            | 25   |
| Porter's Creek formation..       | 26   |
| LaGrange formation .....         | 26   |
| Lafayette formation .....        | 27   |
| Columbia formation .....         | 27   |
| General distribution of deposits | 27   |
| Ripley formation .....           | 27   |
| LaGrange formation ....          | 27   |
| Lafayette formation .....        | 28   |
| Columbia formation .....         | 28   |
| Resume .....                     | 28   |
| Tests on shrinkage, fusibility   |      |
| and colors of West               |      |
| Tennessee clays .....            | 28   |
| Methods employed in              |      |
| making the tests .....           | 28   |
| Tests .....                      | 29   |
| Mining, preparation and          |      |
| manufacture .....                | 30   |
| Mining .....                     | 30   |
| Brick clay .....                 | 30   |
| Potters clay .....               | 30   |
| Grinding .....                   | 31   |
| Dry pan .....                    | 31   |
| Conveyors .....                  | 31   |
| Screens .....                    | 31   |
| Tempering .....                  | 32   |
| Soaking pits .....               | 32   |
| Wet pan .....                    | 32   |
| Pug mill .....                   | 32   |
| Chaser mills .....               | 33   |

|                                  | Page |
|----------------------------------|------|
| Clays of the Area—Con.           |      |
| Molding .....                    | 33   |
| Soft mud .....                   | 33   |
| Stiff mud .....                  | 34   |
| Dry press .....                  | 34   |
| Repress machine .....            | 35   |
| Turning .....                    | 35   |
| Repressing .....                 | 35   |
| Drying .....                     | 35   |
| Burning .....                    | 35   |
| Difference in cost .....         | 35   |
| Scove kilns .....                | 36   |
| Dutch kilns .....                | 36   |
| Downdraft kilns .....            | 37   |
| Continuous kilns .....           | 37   |
| Labor .....                      | 37   |
| Brick output for 1910 ....       | 38   |
| Clay output for 1909 .....       | 39   |
| Selling price of brick and       |      |
| clay .....                       | 39   |
| Selling price and output of      |      |
| stoneware for 1909 .....         | 39   |
| Clay resources by counties ..... | 40   |
| Benton County .....              | 40   |
| Carroll County .....             | 40   |
| Topography .....                 | 40   |
| Railroads and towns .....        | 40   |
| Geology .....                    | 41   |
| Clay deposits .....              | 41   |
| Hico .....                       | 41   |
| Hollow Rock .....                | 44   |
| Huntingdon .....                 | 47   |
| McKenzie .....                   | 49   |
| Trezevant .....                  | 52   |
| Chester County .....             | 56   |
| Topography .....                 | 56   |
| Railroads and towns .....        | 56   |
| Geology .....                    | 56   |
| Clay .....                       | 57   |
| Crockett County .....            | 57   |
| Topography .....                 | 57   |
| Railroads and towns .....        | 57   |
| Geology .....                    | 57   |
| Clays .....                      | 57   |
| Decatur County .....             | 57   |
| Topography .....                 | 57   |
| Railroads and towns .....        | 58   |
| Geology .....                    | 58   |
| Clays .....                      | 58   |
| Dyer County .....                | 58   |

# CONTENTS

2

|                                 | Page |
|---------------------------------|------|
| Clay resources by counties—Con. |      |
| Topography .....                | 58   |
| Railroads and towns .....       | 58   |
| Geology .....                   | 59   |
| Clays .....                     | 59   |
| Dyersburg .....                 | 59   |
| Fayette County .....            | 60   |
| Topography .....                | 60   |
| Railroads and towns .....       | 60   |
| Geology .....                   | 61   |
| Clay deposits .....             | 61   |
| LaGrange .....                  | 61   |
| Follis pits .....               | 62   |
| Moscow .....                    | 63   |
| Somerville .....                | 64   |
| Gibson County .....             | 64   |
| Topography .....                | 64   |
| Railways and towns .....        | 64   |
| Geology .....                   | 65   |
| Clay deposits .....             | 66   |
| Humboldt .....                  | 66   |
| Milan .....                     | 69   |
| Trenton .....                   | 72   |
| Hardeman County .....           | 72   |
| Topography .....                | 72   |
| Railroads and towns .....       | 73   |
| Geology .....                   | 74   |
| Clay deposits .....             | 74   |
| Bolivar .....                   | 74   |
| Bolivar asylum .....            | 74   |
| Grand Junction .....            | 76   |
| Hickory Valley .....            | 76   |
| Middleburg .....                | 77   |
| Middleton .....                 | 77   |
| Rogers Spring .....             | 77   |
| Toone .....                     | 77   |
| Whiteville .....                | 79   |
| Hardin County .....             | 79   |
| Topography .....                | 79   |
| Railroads and towns .....       | 79   |
| Geology .....                   | 80   |
| Clays .....                     | 80   |
| Haywood County .....            | 80   |
| Topography .....                | 80   |
| Railroads and towns .....       | 80   |
| Geology .....                   | 80   |
| Clay .....                      | 80   |
| Henderson County .....          | 81   |
| Topography .....                | 81   |
| Railroads and towns .....       | 81   |

|                                 | Page |
|---------------------------------|------|
| Clay resources by counties—Con. |      |
| Geology .....                   | 81   |
| Clays .....                     | 81   |
| Lexington .....                 | 81   |
| Scott's Hill .....              | 82   |
| Henry County .....              | 82   |
| Topography .....                | 82   |
| Railroads and towns .....       | 83   |
| Geology .....                   | 83   |
| Clays .....                     | 83   |
| Cottage Grove .....             | 83   |
| Henry .....                     | 84   |
| India .....                     | 89   |
| New Boston .....                | 91   |
| Paris .....                     | 91   |
| Puryear .....                   | 92   |
| Whitlock .....                  | 93   |
| Routon .....                    | 97   |
| Vale .....                      | 97   |
| Lake County .....               | 97   |
| Topography .....                | 97   |
| Railroads and towns .....       | 97   |
| Geology .....                   | 97   |
| Clay .....                      | 98   |
| Lauderdale County .....         | 98   |
| Topography .....                | 98   |
| Railroads and towns .....       | 98   |
| Geology .....                   | 98   |
| Clay .....                      | 98   |
| Ripley .....                    | 98   |
| Madison County .....            | 99   |
| Topography .....                | 99   |
| Railroads and towns .....       | 99   |
| Geology .....                   | 99   |
| Clay .....                      | 99   |
| Gilmore .....                   | 100  |
| Jackson .....                   | 101  |
| Malesus .....                   | 103  |
| Medon .....                     | 103  |
| Pinson .....                    | 104  |
| McNairy County .....            | 106  |
| Topography .....                | 106  |
| Railroads and towns .....       | 106  |
| Geology .....                   | 106  |
| Clays .....                     | 106  |
| Selmer .....                    | 107  |
| Obion County .....              | 107  |
| Topography .....                | 107  |
| Railroads and towns .....       | 107  |
| Geology .....                   | 107  |

|                                 | Page |
|---------------------------------|------|
| Clay resources by counties—Con. |      |
| Clay .....                      | 108  |
| Obion .....                     | 108  |
| Rives .....                     | 108  |
| Union City .....                | 108  |
| Shelby County .....             | 109  |
| Topography .....                | 109  |
| Geology .....                   | 109  |
| Clays .....                     | 109  |
| Capleville .....                | 109  |
| Memphis .....                   | 110  |
| Tipton County .....             | 111  |

|                                 | Page |
|---------------------------------|------|
| Clay resources by counties—Con. |      |
| Topography .....                | 111  |
| Railroads and towns .....       | 111  |
| Geology .....                   | 111  |
| Clay .....                      | 111  |
| Covington .....                 | 111  |
| Weakley County .....            | 112  |
| Topography .....                | 112  |
| Railroads and towns .....       | 112  |
| Geology .....                   | 112  |
| Clay .....                      | 112  |
| Martin .....                    | 112  |

## ILLUSTRATIONS

---

|           |                                                                              |               |
|-----------|------------------------------------------------------------------------------|---------------|
| Plate 1.  | Frontispiece. Part of exhibit of clays and clay wares in Geological Exhibit. |               |
| Plate 2.  | Typical view of upland plateau of West Tennessee . . . . .                   | Between 2-3   |
| Plate 3.  | Key Map of West Tennessee . . . . .                                          | " 8-9         |
| Plate 4.  | Typical exposures of Lafayette and LaGrange formations . . . . .             | " 14-15       |
| Plate 5.  | Old and new methods of burning brick . . . . .                               | " 36-37       |
| Plate 6.  | Brick plants of West Tennessee . . . . .                                     | " 38-39       |
| Plate 7.  | Map of clay outcrops at McKenzie . . . . .                                   | 42            |
| Plate 8.  | Map of clay outcrops at Trezevant . . . . .                                  | 53            |
| Plate 9.  | Map of clay outcrops at Milan . . . . .                                      | 68            |
| Plate 10. | Map of clay outcrops at Lexington . . . . .                                  | 78            |
| Plate 11. | Map of part of Henry County, showing clay pits . . . . .                     | Between 82-83 |
| Plate 12. | Clay deposits in LaGrange formations near Henry . . . . .                    | " 84-85       |
| Plate 13. | Clay deposits in Ripley formation, near India . . . . .                      | " 88-89       |
| Plate 14. | Clay deposits in LaGrange formation, west of Whitlock . . . . .              | " 95-96       |
| Plate 15. | Jackson, Madison County, and vicinity . . . . .                              | " 102-103     |

---

|            |                                                                                                          |    |
|------------|----------------------------------------------------------------------------------------------------------|----|
| Figure 1.  | Road exposure, showing formations near Scott's Hill, Tenn . . . . .                                      | 10 |
| Figure 2.  | Road exposure of Porter's Creek clay . . . . .                                                           | 13 |
| Figure 3.  | Clay outcrops and developments near Hollow Rock . . . . .                                                | 45 |
| Figure 4.  | Cross section of road, showing surface formation south of Huntingdon . . . . .                           | 48 |
| Figure 5.  | Cross section of road, showing surface formations on Baxter Hill, 5 miles east of Trezevant . . . . .    | 55 |
| Figure 6.  | Exposure, showing clay lens in Southern railroad, 2 miles east of Moscow, Tenn. . . . .                  | 63 |
| Figure 7.  | Humboldt and vicinity . . . . .                                                                          | 65 |
| Figure 8.  | Cross section of road, showing surface formations, 1 mile west of Milan, on Lower Trenton road . . . . . | 70 |
| Figure 9.  | Hardeman County, showing geological formations . . . . .                                                 | 71 |
| Figure 10. | Bolivar, Hardeman County, and vicinity . . . . .                                                         | 73 |
| Figure 11. | Grand Junction, Hardeman County; LaGrange, Fayette County, and surrounding territory . . . . .           | 75 |



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## INTRODUCTION.

This report deals with the clays of West Tennessee—both those at present worked, and those giving promise on the outcrop, when not too far from the railroads. These clays have a peculiar interest in that West Tennessee is at present furnishing probably the finest ball clay obtained in the United States, as well as sagger, wad and other fine clays, not to mention clays for terra cotta, tile, brick and fire clays. These ball clays have also a large future interest in that the exportation of ball clay from England, the principal source of supply in the past, may be stopped by law in the near future. The value of the report is enhanced further by the fact that, at present, little information on the clays of West Tennessee is available. In his "Clays, Occurrences, Properties and Uses," Reis says (.475) "Probably less is known regarding the clays of Tennessee than those of any other eastern State," the principal papers being two articles of a few pages each by Eckel (1), and Crider (2).

This report is only preliminary in character, dealing primarily with the deposits as found in the field, their location, extent, thickness, character, overburden, geological position, etc. A few of the clays not now worked were burned in a Seger furnace, but a detailed physical and chemical study of the clays will be reported upon later in a special report.

The ball clays found in this section are as good as any in the United States, and have already a large and permanent market in the North where they are eagerly sought after; the demand always being larger than the output. They are at present mined only in Henry County.

Good grades of potters clay are found in many of the counties, and are shipped as well as used locally. At present the local use is small. Fire and brick clays are found in practically all of the counties, but at present fire brick are only manufactured at one locality, Gilmore, Madison County, while the ordinary brick are made in all the towns of any importance. Practically the whole surface of West Tennessee could be utilized in the making of common brick.

In preparing this preliminary report on the western clays, a part of the late fall of 1910 (November and December) was spent in a hurried and brief survey of the field. No detailed work was done and only places were visited where plants were in operation, or where in-

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(1) Eckel, U. S. Geological Survey, Bull., 213, p. 382, 1903.

(2) Crider, U. S. Geological Survey, Bull., 285, p. 417, 1906.

formation had been given in regard to "blossoms." No drilling or prospecting work was done, as the time was too short. In several instances information was procured by correspondence from owners of mines and well drillers.

It is the intention of the Survey later on to publish bulletins of the clays of Middle and East Tennessee, making, when finished, a complete preliminary clay survey of the State.

## GEOGRAPHY OF AREA.

### LOCATION.

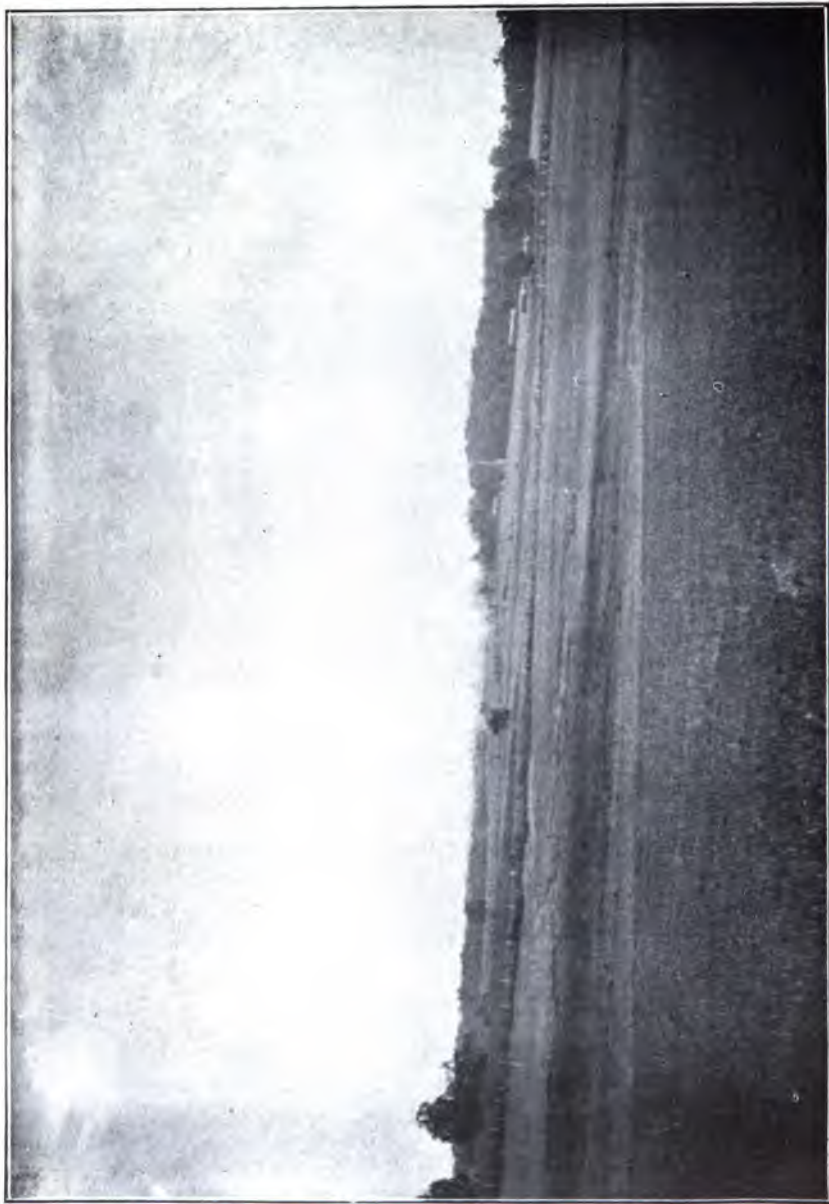
This report describes that part of Tennessee which lies between the Tennessee and Mississippi rivers. A large share of the time was spent in a belt extending through Henry, Carroll, Gibson, northwestern Henderson, eastern Madison and Hardeman counties, as that is the belt known to contain the clays of highest grade. The rest of the district was covered only in a very reconnoissance manner.

### TOPOGRAPHY.

*General character*—The surface of the part of Tennessee under discussion varies from very broad flood plains along the main streams and their principal tributaries to a gently rolling and hilly surface along the valley sides and in the areas between the streams. Sometimes the divides are level and plateau like, bordered by steep and irregular slopes on the edge of the valleys, which vary from a few yards to several miles in width. At present most of them are subject to overflow at all times of the year. The larger valleys have also an older flood plain, which is known as the "second bottoms," and is separated from the present flood plain by a well defined escarpment of from two to fifteen feet or more.

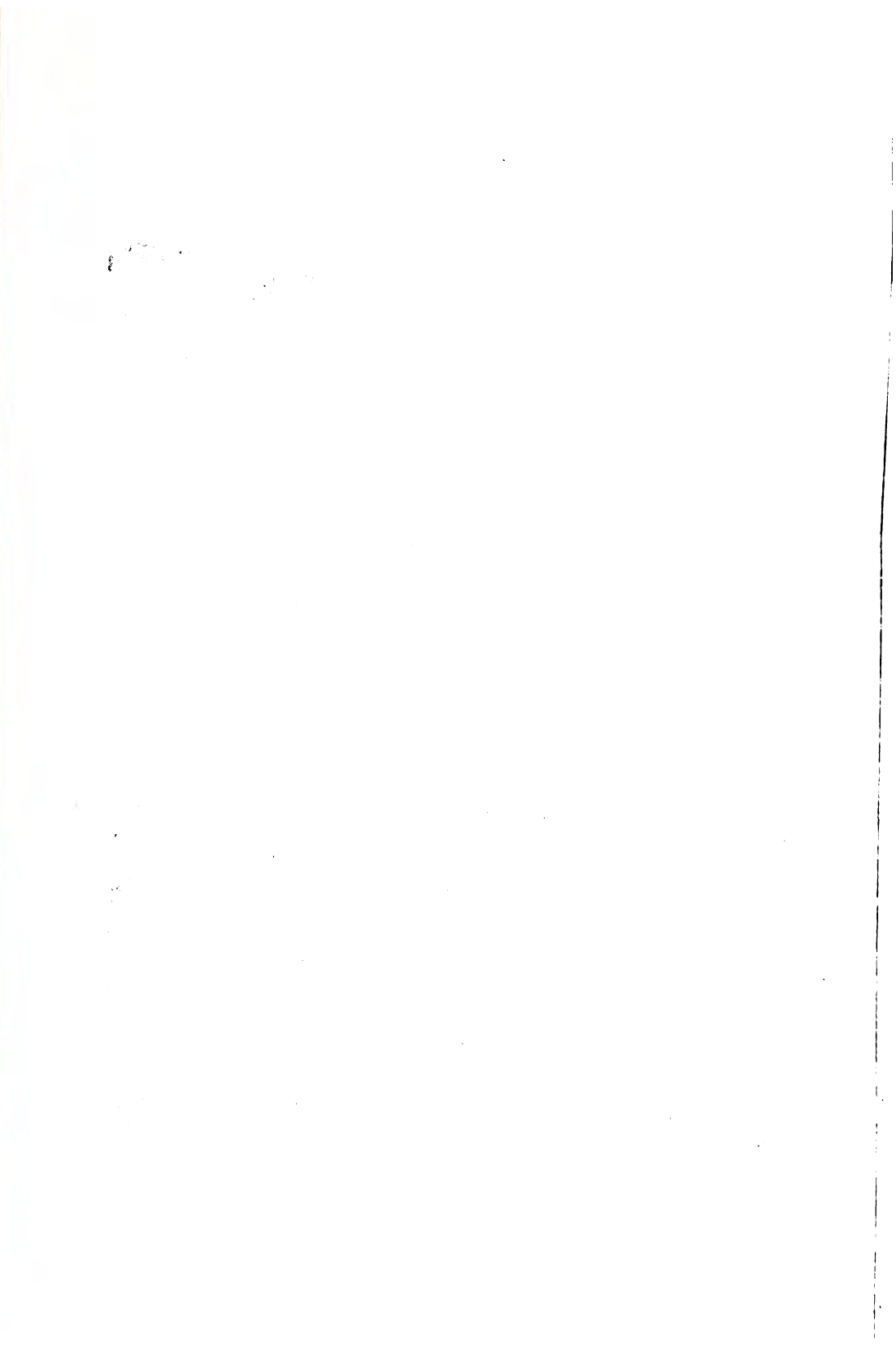
*Tennessee-Mississippi divide*—This divide, the principal one in West Tennessee, separates that portion of the State into two distinct drainage areas, of very unequal size. It runs northward parallel to the Tennessee River, and at a distance from it of from ten to twenty-five miles, having a height which averages 450 to 500 feet, though in places it reaches an altitude of 600 feet. This ridge being near the Tennessee River, makes the Tennessee drainage slope short and steep, with small streams flowing directly into the Tennessee River; though in the northern part, the main stream, the Big Sandy, attains considerable length by flowing parallel to the Tennessee River, before emptying into it. West of the divide the general slope of the surface is long and gentle.

PLATE 2.



TYPICAL VIEW OF UPLAND PLATEAU OF WEST TENNESSEE.  $\frac{1}{2}$  MILE NORTHWEST OF HICO.





The main streams, such as Wolf, Hatchie, Forked Deer and Obion, flow directly into the Mississippi. These streams do not, as a rule, furnish opportunities for water power development, as the fall per mile is very small. Instead, most of them are bordered on both sides by cypress swamps, though under a recent law active measures are being started to reclaim these rich bottom lands.

The slope from the Tennessee-Mississippi divide eastward is gentle, but there is an abrupt drop along the Tennessee River of one hundred to two hundred and fifty feet to the river flood plain. Westward the slope is in general to the west, but locally the slopes are to the main drainage streams. (See Plate 2.) The general westward slope is broken by a ridge that extends northward from the Mississippi State line through McNairy County, and by a number of high hills of a general elevation of 550 feet, which extend up from Grand Junction, through Jackson, Milan and Paris, along the eastern outcrop of the LaGrange sands, and its interbedded clay lenses. These two features, which may be distinguished for want of better names as the "residual ridge" and hills of arosion" are described in succeeding paragraphs.

*Residual ridge*—This ridge is about one half mile wide and between one hundred and two hundred feet high. It extends from Mississippi, northward into the southwestern part of McNairy County, where it gradually dies out. It is caused by the presence of a large amount of concretionary ironstone, with which its sands have been cemented by percolating waters. This has protected the underlying Ripley sands from erosion, while the areas on either side have worn away. A good exposure of this is found in the "big cut" just west of Cypress Station, where the Southern Railway crosses this ridge.

East of this ridge, in the southern part of the State, the Eutaw sands and Selma clays, which form the eastern outcrops of the embayment deposits in southern Tennessee, are cut into steep hills. This is caused by their situation on the short steep drainage slope of the Tennessee River; and also on account of their composition, since they are easily eroded.

*Hills of erosion*—In the eastern part of the LaGrange formation an unusually hilly belt extends across the State from Hardeman to Henry counties. These are developed best around the town of LaGrange in Hardeman County, and at Cottage Grove in the northwest part of Henry County. The materials are easily eroded, being soft sands with lenses of clay interspersed. In an abandoned field, gullies will soon form, and in several years make the land worthless. The gullies average 20 to 30 feet, but under favorable conditions they will be over

120 feet deep. It is by the aid of these gullies that most of the prospecting for clay is done in this region, and all of the best pits occur in this belt of hills.

*The flatwoods*—This name is given in Mississippi to that portion of the country which is underlaid by the Porter's Creek formation, as it is of more than average flatness. In Tennessee, only in the northern portion of the State near the Kentucky border line, do such conditions prevail, the surface over the Porter's Creek formation in the rest of the State having no distinctive features.

*Alluvial region*—West of the line of bluffs which terminates the uplands of West Tennessee, there are alluvial bottom lands, along the Mississippi River, which are part of the flood plains of that river. Part of them are low ridges which are high enough not to be submerged under high water. So we have a surface which is flat, but broken by low ridges a few feet high or by old stream channels, "cut offs," partly filled with water. On the river bank in many places, the land is somewhat higher, forming bluffs about fifty feet high, as at Memphis, which is generally cultivated; while back from the river to where the uplands commence, the land is swampy and uncleared. The elevation of this land is from about 215 feet at the Tennessee-Mississippi State line to about 300 feet at the Tennessee-Kentucky line.

#### ORIGIN OF TOPOGRAPHY.

All the surface inequalities of West Tennessee are due to erosion with the exception of a small area around Reelfoot Lake, in the northwest corner of the State, where there were disturbances in 1811 and 1812, during the New Madrid earthquake. The surface was originally a plain, formed by deposition, under marine conditions, when West Tennessee was an embayment of the Gulf. This gulf bottom was subsequently lifted up and since then completely dissected by stream erosion into its present topography. There were in this general uplift several minor periods of uplift and depression; probably with a subsequent slight warping or tilting.

The erosion has been slight on account of the low elevation of this region. So the streams soon cut as deep as they could, then began to broaden their valleys, and forming their flood plains of several miles extent; then came a slight depression, which was very brief, during which a light deposit of loess was laid down; then came the uplift, and the streams commenced cutting away their flood plains, and forming new ones from five to fifteen feet lower, which have attained a width of not more than a mile and a half. All of this has occurred in a com-

paratively short time, as the formations are composed chiefly of soft sands and clays.

*Origin of flatwoods*—The origin of the "residual ridge" has already been given, but that of the "flatwoods" has not. The "flatwoods" are caused by the impenetrability of the Porter's Creek clay to water, thus causing nearly all the water to run down the sides of hills into the streams. On any steep slope, that would tend to develop a stream by cutting, the amount of material carried down by the water would be so great that it would prevent any deepening of the stream bed. Instead it would fill it up and make it build broad flood plains. Thus in time there would be a general lowering of the whole area, with gentle slopes to the streams.

*Origin of "hills of erosion"*—In the sand areas, which contain the "hills of erosion," the effect of the water is entirely different. Here the old level of the hilltops will remain almost unchanged, as the rain is absorbed immediately and soaks down to ground water level, and only at this level would streams be formed. Such streams would immediately commence washing away the sands in its way, and on the addition of more rain would deepen its channel, for most of the water would sink through the sands and come into the stream in that manner, instead of running down the slopes and washing in materials to fill up the channel. In such a formation there would be very few surface rivulets to rapidly erode the sides of the hills, so they would naturally waste slowly. In such a manner are most of the hills formed, which at present are the source of the best West Tennessee clays.

*Disturbances*—A warping has changed the uniformity of the general westward slope of the embayment deposits in Tennessee, so that the same rock that in the southern part near Memphis, may have an elevation of 300 feet above sea level, along the northern part at the Kentucky-Tennessee line, may have an elevation of 450 feet. The elevation which would have maintained along this north and south line, if no warping had occurred, would have been 350 feet. This more elevated area is near that portion of Tennessee which was affected by the New Madrid earthquake of 1811 and 1812. As there is no terracing or ponding in this region, it seems improbable that that region underwent a raise of one hundred feet, such a short time ago, when, from what is known of the topography around there, we have no indication of it. But on the other hand we have indications of disturbances as far back as Eocene times, shown by the sandstone dikes in the Porter's Creek deposits. From this it seems that this elevation

and the depression near Memphis were both caused by a series of movements extending from Eocene times to the New Madrid earthquake of 1811 and 1812, each having a movement of several feet.

#### GENERAL DEVELOPMENT.

The general development of West Tennessee, as a whole, is variable. In spots good crops are raised, though there is hardly a place where the quantity could not be doubled with proper care and attention being given the land. Fertilizers are used but little, and in most places the land is only plowed once a year, in the spring. The crops, in many parts of the area, are not rotated, and in the cotton areas, that commodity has been raised year after year, even before the Civil War. Nearly all of the land in the river bottoms is without any drainage system. This land will make some of the finest farms in the State when a proper system of drainage is employed, but as it is, a great deal of it is swampy and covered with a secondary forest. Away from the larger towns this land can be bought for a few dollars an acre, but the general price, is about \$10 to \$20. The timber on these lands will generally pay for the expense of clearing. In the few places where drainage work has been done, identical lands sell now up to \$100 an acre. Many old cultivated fields, which have been left idle for several years, have been absolutely ruined by the enormous gullies, which have been washed in them, when a little attention at first would have prevented such a state of affairs. A little straw or cane put in the bottom of these gullies would have caught the wash dirt and soon refilled them.

*Railway facilities*—Portions of West Tennessee have all the railroad facilities that they need, while there are other portions in which transportation facilities are woefully lacking. In general the competition between any of the railroads is so slight that rates are higher than are found further north. This is one of the reasons why no large potteries are located in this State. The following railroads enter West Tennessee: Nashville, Chattanooga & St. Louis; Louisville & Nashville; Illinois Central; Mobile & Ohio; Southern; Kansas City, Memphis & Birmingham; and the Yazoo & Mississippi Valley railroads. The Illinois Central parallels the Mississippi River, and controls all that territory except at the northern boundary around Union City, where the Mobile & Ohio and Nashville, Chattanooga & St. Louis act as feeders, and on the south at Memphis, where all the roads except the Mobile & Ohio connect. The Chicago, Memphis & Gulf is a short line which runs from Tiptonville on the Mississippi River to

Dyersburg, where it connects with the Illinois Central. This road is to be extended in the near future to Jackson, through the towns of Friendship and Alamo, most of the stock having already been subscribed. The Nashville, Chattanooga & St. Louis and Louisville & Nashville cover West Tennessee from east to west, and also along the Tennessee River, while the Illinois Central and Mobile & Ohio run in a general north and south direction through the center, crossing at Jackson. The Southern Railway runs from Memphis along the State boundary, finally crossing into Mississippi.

*Character of roads*—Except in a few localities the roads in West Tennessee are very poor in winter, being in many places a succession of mudholes. In several localities pikes have been made, notably around Jackson, in Madison County, where they have piked all the roads, for a distance of five miles, and are grading them all over the county. Around Memphis the pikes extend out several miles, there being over 600 miles of novaculite roads in Shelby County, while in several of the smaller towns the roads are piked out for half mile, as at Paris in Henry County, and Humboldt in Gibson County. The roads over the rest of this territory are unimproved except for "corduroying" in some places. The working of the roads is generally done by people who know little about it and consists in running a plow along the side and then pitching the dirt along the side of the road, thus making the road low in the middle and high on both sides. Very seldom do they round the roads. In many places the top soil being sand and clay, is mixed in such proportions as to make a good sand clay road, if the road-bed would only be kept well rounded. The correct proportions for this kind of road is about 85 per cent to 90 per cent sand, and 10 per cent to 15 per cent clay, and as both of these materials are found all over West Tennessee, they could easily have good roads. The pikes are made from novaculite, which is mined in Camden.

*Cities and towns*—Memphis, with a population of 131,105, is the only city of size in this portion of the State, and is situated in the southwest corner, on the Mississippi River. It is the metropolis of Tennessee, and one of the largest cotton centers, hardwood markets and distributing points in the South. Jackson is the largest of the smaller cities, a thriving town with a population of 15,000, situated in the center of West Tennessee, at the junction of the Mobile & Ohio, Illinois Central and Nashville, Chattanooga & St. Louis railroads. All over the rest of this territory the country is dotted with thriving towns of from 5,000 inhabitants down; of these the most prosperous are Union City and Paris, while the towns of several thousand include

Obion, Dyersburg, Ripley, Covington, Brownsville, Humboldt, Milan, Trenton, Martin, Dresden, McKenzie, Huntingdon, Lexington, Henderson, Selmer, Bolivar, Somerville and Camden. Most of these towns are equipped with waterworks systems and electric lights, and are in a thriving condition.

### GEOLOGY OF AREA—STRATIGRAPHY.

*General Statement*—In this region the deposits consist of sands, gravels and clays, ranging in age from Cretaceous to Recent. The deposition was not continuous, but was broken by several slight up-risings, causing unconformities to exist between several beds. In many places, the sand may be cemented into ferruginous sandstone by the action of the percolating waters. This ironstone or ferruginous sandstone varies from a fraction of an inch to a little over a foot in thickness, and often is found at the base of the sand, lying directly over a clay lense. In this case the descending waters carrying the iron in solution have been stopped by the clay, the iron deposited just above it has formed an ironstone of the sand. As a rule, the overlying sands are easily removed by a shovel from the clay, but in several places the iron has so hardened it that it is very difficult to remove cheaply. In the east in place of an iron sandstone, we often get, where there is gravel, a ferruginous conglomerate, but this lies, as a rule, near the surface, and is easily undermined and washed away, as it does not occur continuously.

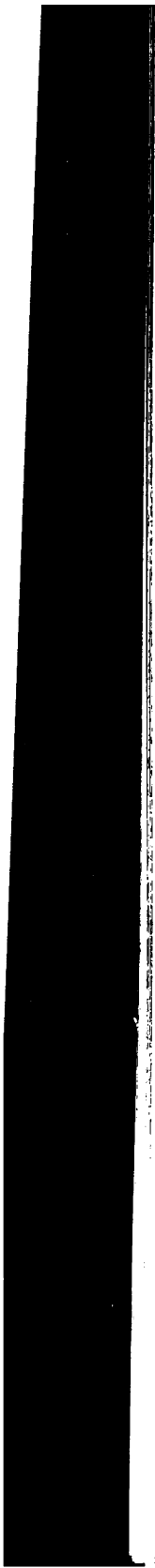
### FORMATIONS DESCRIBED AND THEIR DESCRIPTION.

The geologic formations of the Gulf embayment of this region given in order from the oldest to the youngest, are the Eutaw sand, Selma clay, and Ripley formations of the Cretaceous; the Porter's Creek and LaGrange of the Eocene; the Lafayette formation of the Pliocene; the Columbia sand, loess and loam of the Pleistocene, and the river alluvium of the Recent age. These lie on the Paleozoic rocks.

### PALEOZOIC ROCKS.

These rocks come to the surface along the west bank of the Tennessee River, and as you go westward slope under the embayment deposits, being at a depth of 500 feet at Lexington, and at Memphis, if the same dip continues, and the maximum thickness of the beds be taken, it would be reached at a depth of 2300 feet. At the southern line the rocks belong to the Mississippi series of the Carboniferous,

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while in the northern part of Hardin County, and in the Southern part of Benton County, the floor is of Silurian limestones. Again, in the northern part of Benton County the Mississippian series reappear, while still further north in Henry County the beds are of Silurian age.

#### CRETACEOUS SYSTEM.

##### EUTAW SAND.

*Extent*—This deposit is the oldest of the embayment deposits in Tennessee and rests on the rocks of the Paleozoic floor. It outcrops as the eastern edge of the embayment deposits in Hardin and Decatur counties, and the southern edge of Benton County. It extends northward with a slight eastward deflection into those counties from the Mississippi line at which place it has a width of eight miles. From its outcrop it extends westward, going under the other beds and possibly underlying a large share of the region at a depth which increases to the west.

*Lithological character*—The Eutaw formation is chiefly composed of sands, which are interbedded with thin layers of clay. These beds were laid down in shallow water, where shifting currents predominated, thus making cross bedding a prominent feature in this formation. In an exposure of 200 yards the beds will grade quickly from a sand to a clay and back again, or lenses of clay will appear for short distances. In places the sand and clay alternate in their layers of several feet. On account of these quick variations the thickness of the Eutaw sand varies greatly, and the different beds 25 yards apart will not agree at all. At Parsons, Tenn., just east of town in the Nashville, Chattanooga & St. Louis R. R. cut, at the base, are  $3\frac{1}{2}$  ft. of angular chert pebbles, up to eight inches in diameter overlaid by very thin layers of a dark lignitic shale, slightly sandy. Between these layers, in places, are thin beds of coarse pebbly material 5 inches in diameter, composed of chert. Further on these beds are overlaid by cross bedded sands, which contain some gravel composed of chert, about 1 inch in diameter. In this sand appear in places several layers of leaden or brown clay; on, still further, these beds where they go under the track, are covered by about 20 feet of dark greyish-blue clay, overlaid by about 10 feet of light grade sandy clay.

*Section*—The best exposure of the Eutaw sands is at Coffee Bluff in Hardin County on the west bank of the Tennessee River, where 215 feet are exposed. The following is an exposure seen on the east side

of the road from Lexington to Scott's Hill, in Henderson County, half mile from Scott's Hill:

*Section near Scott's Hill, Henderson County.*

|                                                                                                                                                 | Feet         | Inches |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|
| Dark red sandy clay—case hardened .....                                                                                                         | 8            |        |
| Lafayette, some gravel mixed in it.                                                                                                             |              |        |
| Ironstone pan .....                                                                                                                             |              | 4      |
| Beds of orange sand with several ironstone pans of an inch or two thickness interspersed and little spots of sand from decomposed pyrites ..... | 2            | 4      |
| Ferruginous sandstone, cross bedded .....                                                                                                       | 2            |        |
| Ferruginous sandstone, cross bedded .....                                                                                                       | 3            | 6      |
| Ferruginous sandstone, cross bedded .....                                                                                                       | 3            | 6      |
| Ironstone .....                                                                                                                                 | 1 inch to    | 4      |
| A dirty blue and light grey clay, sandy at top and streaked with yellow and red .....                                                           | 25 to        | 30     |
| Ironstone pan .....                                                                                                                             | .6 inches to | 12     |
| Micaceous, very dark grey silty clay with pieces of lignite scattered through it .....                                                          | 25           |        |

At this place the road runs 45 degrees west of north.

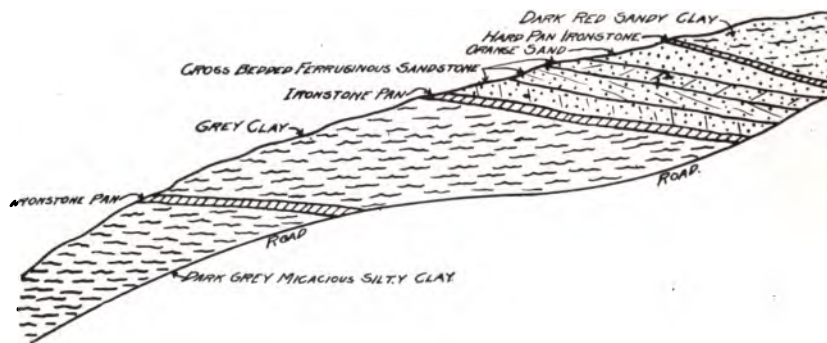


FIG. 1.

ROAD EXPOSURE, SHOWING FORMATIONS NEAR SCOTT'S HILL, TENN.

**Thickness and dip**—The Eutaw sands dip westward at a low angle and pass beneath the Selma clay. The exact measurements of this bed have never been made, but from the best data available their thickness is thought to be from 275 to 360 feet thick. No record could be gotten of the well which passed through it at Lexington.

#### SELMA CLAY.

**Extent**—The Selma clay rests on the Eutaw sands and outcrops west of it in a belt which extends northward about half through the State, with a width of 8 to 10 miles. The Selma clay extends westward under the newer formations to the Mississippi River, where it would be reached at a depth of about 1600 to 1700 feet.

*Lithological character*—This clay is of a leaden grey or greenish color when dry, but when wet it becomes nearly black. Certain parts get their green color from grains of glauconite which are present. In many places fossil shells are found in abundance, some of them very large. A collection of these was gotten in McNairy County on the road from Guy to Gravel Hill,  $2\frac{1}{2}$  miles from Guy. At this place the Selma clay covers the whole surface of the hill. At this same place were found several vertebra of some extinct animal, probably an ichthyosaurus.

*Section*—An outcrop of this deposit was visited on the old road which used to go to Shady Hill from Lexington. In Henderson County where the road goes up a hill  $1\frac{1}{2}$  miles from Shady Hill, the following section occurs:

| <i>Section <math>1\frac{1}{2}</math> miles from Shady Hill.</i> |                     | Feet |
|-----------------------------------------------------------------|---------------------|------|
| Light orange sandy clay .....                                   | 15                  |      |
| Dark green micaceous clay containing many shells .....          | 8                   |      |
| Hard shaly limestone containing shell fragments .....           | $1\frac{1}{2}$ to 2 |      |
| Dark green micaceous sandy clay with many large shells .....    | 5                   |      |

This reached to base of hill and under.

From this section it will be seen that certain of the beds are very sandy, but no pure beds of sand have so far been found.

This clay has given especial trouble in "Blue cut" in McNairy County on the Mobile and Ohio Railroad, causing the track to slide. On becoming wet, it takes on a blue color, and becomes very sticky, while on drying it cracks and becomes yellowish.

*Thickness*—The Selma clay is thickest at the Mississippi line, reaching down about 375 feet, while as it goes north it thins out, until at Lexington it has a thickness of about 100 feet.

#### RIPLEY SANDS.

*Extent*—The Ripley sands extend northward entirely across the State, passing through Hardeman, McNairy, Chester, Henderson, Carroll, Benton and Henry counties. The width of its outcrop ranges from about 15 miles in the south to about 6 miles on the northern boundary.

*Lithological character*—This formation is composed mostly of stratified sands, showing a great variety of colors, such as pink, red, purple, orange or grey. The sands are usually fine gravel, and between them are found beds of grey lignitic or a yellow sandy micaceous clay. In many places these beds are highly ferruginous; having more iron in them than any other of the formations found in West Tennessee, except the Lafayette. Near the surface the iron is peroxidized and gives

the sands a very deep red color. The colors of the Ripley and Lafayette are often so similar that great difficulty is experienced in establishing their boundaries when they come in contact.

At certain horizons the iron acts as a cement, and has changed the sands into sandstones and sand ironstones. These ironstones assume many curious shapes, especially that of long hollow tubes, perfectly round, others are flattened, large at one end and small at the other. The variety of forms taken seems unlimited. In the "Big cut" on the Southern Railroad in McNairy County, the pipes are cemented together, forming a honeycombed mass, which protects the underlying sands from erosion. It is these sandstone layers which, by protecting the underlying beds, cause the Ripley sands to extend as an elevated ridge up into the southern part of Tennessee. As before mentioned the rainfall soaks into the sand in much larger proportion than in the clay areas.

*Section*—The following section is taken from Dr. L. C. Glenn's Water Supply and Irrigation Paper, 164:

| <i>Section of Ripley formation near Cypress, Tenn.</i>                                                                                                                                                                    |       | Feet |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|
| 1. Red case-hardened Lafayette sand and clay, with a few broken pieces of ferruginous sandstone and scattering quartz pebbles marking the contact with the underlying Ripley .....                                        | 8     |      |
| 2. Fine red sand and clay, with rolled clay pellets and thin streaks of white clay .....                                                                                                                                  | 20-25 |      |
| 3. Concretionary tubular sand ironstone in single pipes or in masses of parallel ones, with soft sand cores .....                                                                                                         | 2-8   |      |
| 4. Fine variegated sand, having, as a whole, a light greyish color, but showing in detail red, white, brown, yellow and purple streaks or mottling. Case-hardened, so that it breaks off in large masses....              | 20    |      |
| 5. Ferruginous sandstone pipes and fluted masses as above .....                                                                                                                                                           | 0-20  |      |
| 6. Fine sand and clay interbedded in thin laminæ; yellow, brown, cream, or grey; sands micaceous; leaf and other plant markings common but indistinct and unidentifiable, exposed down to 15 feet below track level ..... | 35    |      |

The following section occurs on the road from Scott's Hill to Lexington, on the hill going down to Piney Creek:

| <i>Section on Piney Creek.</i>                                               |       | Feet |
|------------------------------------------------------------------------------|-------|------|
| At the top of hill. Dark orange or blood orange sand, incoherent .....       | 15    |      |
| Layers of slaty shale, interbedded with layers of light orange sandy clay..  | 15-20 |      |
| Light grey clay, gritty .....                                                | 3½    |      |
| Going on toward Lexington the road rises about 50 feet in the next mile.     |       |      |
| Further on blood orange sand interbedded with layers of iron hard pans ..... | 20    |      |
| Further on white sand, with yellow tinge .....                               | 8     |      |
| Further on orange sand, case-hardened and clay pellets to the top .....      | 15    |      |

*Dip and thickness*—The dip of the Ripley formation is the same as the underlying older beds. Its thickness is not exactly known, but in southern Tennessee it is thought to be about 500 feet.

## TERTIARY SYSTEM.

## EOCENE SERIES.

## PORTER'S CREEK FORMATION.

*Extent*—The Porter's Creek formation, which is the oldest Eocene deposit of this region, rests unconformably on the underlying Ripley of the Cretaceous. It outcrops directly west of the Ripley sands in a belt from 4 to 8 miles wide, which extends entirely across the State, and dips westward under the newer beds, underlying the State to the Mississippi River, where it is reached at a depth of 1066 feet at Memphis.

*Lithological character*—This formation is composed of a fine grained clay, grey when dry and micaceous, which on becoming wet, gets very black. It is called "soapstone" all over this region by the inhabitants. In the lower part of this formation the clay is interbedded with a very fine micaceous sand, while in places are found beds of green sand which contain some glauconite.

Sandstone dikes, which vary from a fraction of an inch to several feet intersect these beds of grey clay in some places. As a rule, these dikes are only several inches thick, and may run parallel or in any direction. Some run entirely through the beds, and others ending blindly, or curving and coming back to the main dike.

*Section*—On the Reynoldsburg road, one mile south of Paris, several of these dikes are exposed in a road cut.

| <i>Section of cut 1 mile south of Paris.</i>                                                                                                    | Feet | Inches |
|-------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|
| Light orange sandy clay, very few pebbles Lafayette formation..                                                                                 | 5    |        |
| Porter's Creek clay, grey, micaceous, with iron streaks and containing perpendicular fissures of very fine micaceous sand from 2-8 inches ..... | 5    |        |
| Fine micaceous sand from which the dikes run upward .....                                                                                       |      | 5-8    |
| Porter's Creek grey micaceous clay to road bed .....                                                                                            | 4    |        |

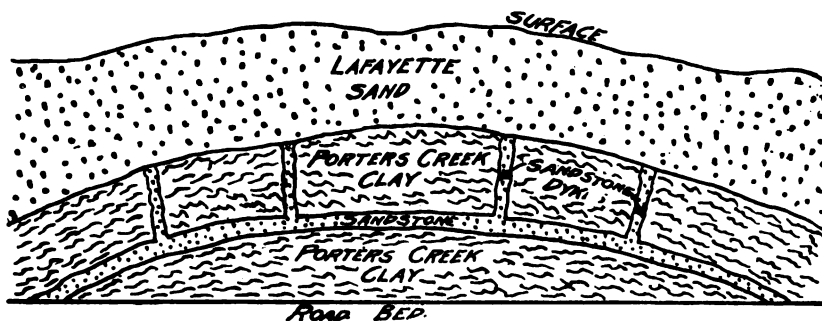


FIG. 2.

ROAD EXPOSURE OF PORTER'S CREEK CLAY

All along this road for several miles further on the formation comes into view again and again, overlaid in most places by several feet of Lafayette sands. These fissures seem to be the result of earthquake movements during the Eocene times, the sand being forced up into the fissures along with water, making a quicksand, on account of the particles of mica present. They later on became hardened into sandstone dikes.

*Thickness and dip*—The dip of the Porter's Creek formation is the same as the underlying Ripley beds. Its thickness as gotten from the well at Jackson is 175 feet, at Memphis it is 155 feet thick.

#### LAGRANGE FORMATION.

*Extent*—This formation is the thickest, and covers more area than any other in West Tennessee; although it has the least surface exposure. It is in this formation along its eastern outcrop that all the best clay deposits, especially ball clay, are found. The eastern edge of the LaGrange formation extends from the southwestern part of Harde-man County; then north—northeastward through Chester, Madison, Henderson, Carroll and Henry counties, all of the area of this line is underlaid by the LaGrange at no great depth. This embraces about two thirds the area under discussion. This formation is nearly all covered, to a slight depth along its eastern portion in the foothills, by the Lafayette and the Columbia loess and loam, while in the river bottoms that which has not been cut away is covered by alluvial deposits.

*Lithologic character*—The LaGrange formation consists of interbedded sands, clays and lignitic material. The largest part is composed of sand, which is mostly fine-grained, though in places there are very coarse beds found, which grade into local gravel deposits. The color of the sand is light yellow or cream, though in places it has streaks of brown or purple. Lignitic material darkens the sand in many places.

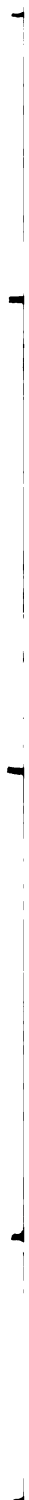
The clays of this formation are the best in West Tennessee, grading from fine ball clay down to common brick clay, with all intermediate varieties. In the clay lenses, which occur mostly on the eastern outcrop, there are often streaks of very dark lignitic clay, several feet deep, which grade into a light grey, or change abruptly into a pink or light yellow. The purest clay is found toward the center and bottom of the lenses; that around the edges and top, on account of the impurities in it, such as sand, being used for saggers. These lenses, as a rule, cover several acres only in extent, and are elliptical in shape,



FIG. A. TYPICAL EXPOSURE OF LAFAYETTE FORMATION.  
¾ mile west of Camden.



FIG. B. TYPICAL CLAY BLOSSOM IN LAGRANGE, OVERLAID BY LAFAYETTE SANDS.  
½ mile south of McKenzie.



with their long axes extending, several degrees west of north, in Henry and Carroll counties, while in Madison and Hardeman counties they extend east of north. These observations refer to the workable deposits in the Ripley as well as the LaGrange. These clays are highly siliceous, especially the fine-grained, white or grey plastic clays. These have resulted from the thorough disintegration of the cherts in the old nearby Paleozoic rocks.

The clay is mined at present principally in Henry and Hardeman counties, although there are small pits in Carroll and Madison counties. In many of the pits are found layers of clay which are full of a great variety of leaf impressions. Some of the leaves are so well preserved that part of the old tissues are still preserved; while others have only the impression of the leaf left in a beautiful pink color. This is caused by waters carrying down iron in solution till the leaf surface is reached, where the iron is dropped as a thin film on its surface. This takes the impression of the leaf and preserves it long after the leaf has rotted away.

In the upper parts of the formation along the Mississippi River are found beds of dark lignitic clays, which are penetrated in wells in that section. At Memphis, there is about 200 feet of blue clay at the top of the formation. As far as known this bed is not continuous.

Lignitic material is found in several places in the LaGrange formation, mostly along its eastern outcrop. These beds are several feet thick and have been used for burning in some places, but in all cases the results have been so poor that the attempt has been given up. All attempts to mine this has been unsuccessful. In the west along the Mississippi River natural exposures are known.

*Section*—The best view of these beds is gotten at the town of LaGrange in the southeastern part of Fayette County, from which the beds get their name. The town is on a high divide, having a steep slope to the south, which forms the northern side of the valley of Wolf River. The river is a mile away and 200 feet lower.

This steep slope has been greatly eroded, and ravines 100 to 175 feet deep are eating northward, and undermining the south side of LaGrange. The ravines in their numerous ramifications present a fine opportunity for a study of the LaGrange formation, as well as the overlying deposits. The following is a section exposed in a ravine south of town on the road leading south of Wolf River:

*Section at LaGrange.*

| Columbia:                                                            | Feet  |
|----------------------------------------------------------------------|-------|
| 1. Soft, loose, light-yellow to light gray sands, cross-bedded ..... | 15-18 |
| 2. Soil layer, dark with organic matter .....                        | 1     |

## Lafayette:

Feet

3. Massive bed of brick-red sand, case-hardened, showing very even top but very irregular lower surface and resting unconformably on the underlying sand ..... 4-15

## LaGrange:

4. Soft cross-bedded sands, mostly fine but in places coarse, of various light colors such as nearly white, light yellow, faint pink, and faint purplish with a few thin crusts and small rounded or short tubular concretions of sand ironstone in places. Near the top there is a clay lens of irregular shape ranging up to 8 or 10 feet thick ..... 100

*Fossils*—Many plant remains have been found in the clay beds of this formation, especially in the pits at Puryear; Henry Clay Company, near Henry; on the Illinois Central Railroad south of Grand Junction. These fossils determine the LaGrange formation to be of Eocene age.

*Thickness*—This formation dips from the edge towards the center of the basin. Its thickness at Memphis is 936 feet, while at Jackson, on its eastern edge, only a thickness of 148 feet remain.

The beds were called the Orange sands, as well as LaGrange, by Safford, in his *Geology of Tennessee*. The term orange has now been discarded on account of the confusion arising from the use of this term.

## PLIOCENE SERIES.

## LAFAYETTE FORMATION.

*Extent*—The Lafayette formation extends over all the above mentioned formations, and further eastward over the Paleozoic rocks as a thin blanket covering the country. It is composed of sand and gravel and averages less than 20 feet thick, though in places it reaches over 30 feet.

It has been removed where the streams have cut down into the underlying formations, but it is a continuous bed except in places where the Selma or Porter's Creek clays outcrop. In these places as explained on page 5 it has been washed away by erosion, while the sand formations on either side retain it.

*Lithologic character*—These beds are composed mainly of sand, of a very ferruginous character, giving the formation a dark red or orange color. In places it is cemented into a cross-bedded sandstone, with or without clay pellets and gravel.

In places there are local gravel beds composed of novaculite, quartzite and chert. This phase is found only near the large rivers, as the Mississippi and Tennessee. When the gravel is present the line of unconformity between the Lafayette and underlying formation is easily recognized.

At the base of this formation is often found an ironstone hard pan of from several inches to a foot in thickness, caused by the percolating waters, where they come in contact with clay lenses in the underlying LaGrange.

The red sandy clay, which makes up a great part of this formation, is generally used over this part of the State for making common red bricks. Only the top 6 or 8 feet can be used as it gets too tough below that depth to be worked.

*Section*—Road exposure 2 miles from Paris on way from the Mandle-Sant pit No. 7.

*Section of Lafayette 2 miles northeast of Paris.*

| Lafayette:                                           | Feet |
|------------------------------------------------------|------|
| Red sand, with sprinkling of gravel .....            | 8    |
| Very dark sand, full of gravel .....                 | 4    |
| LaGrange:                                            |      |
| Cross-bedded sandstone, red to bottom of gully ..... | 15   |

*Thickness*—The thickness of these beds is nowhere 50 feet in Tennessee, while in most places only a covering ranging from 2 to 15 feet is found. Their greatest thickness is near the Mississippi River, where they are covered by the Columbia formation.

#### QUATERNARY SYSTEM.

##### PLEISTOCENE SERIES.

##### COLUMBIA FORMATION.

*Extent*—Under the name Columbia formation are grouped three deposits. The lowest and oldest is a loose sand which is directly over the Lafayette and under the loess, which is the second deposit included. On top of the loess is a loam which overlies the latter where it is found, and extends eastward over the Lafayette as a thin mantle. These deposits are thickest along the Mississippi River where they form the bluffs.

*Lithologic character, Sands*—Along the Mississippi River, where the loess does not rest unconformably on the Lafayette, there is a loose, soft, light-colored sand. This sand contains rounded chert pebbles, like those in the underlying Lafayette, showing that the deposits is worked over from the older beds. It grades up into the overlying loess without any distinct break, and where the sand is absent the lower part of the loess is sandy in its nature.

*Loess*—This member extends east from the Mississippi for 20 to 30 miles. It has a thickness of 50 to 75 feet in the river bluffs. From this it thins out to a thin mantle as it goes eastward, and then disappears. On this account no exact eastern boundary can be fixed.

The loess is composed of two phases, a lighter, upper one and a lower, darker member. The lower one is denser and more plastic, and is used to make drainage tile out of, and also brick, while the upper one is porous, with open-texture, and can only be used to make common brick, as it has little plasticity. The two members of this loess are well defined in the cut at Curve in Landerdale County, where the Lafayette is overlaid by a loose high-colored sand with gravel from several inches to 3 feet in thickness, and gradually changes into a dark loess, while above this is a distinct layer of light-colored loess.

The loess is considered to be a material composed of finely ground rock flour resulting from glacial erosion. How it was deposited, whether by wind or by water, has not been settled, although the evidence seems to point to a fluvial origin.

*Loam*—The loam, which is the third member of the Columbia formation, is found to the east of the loess, and seems to be a continuation of it, though it sometimes overlays it. It is yellow or brownish in color, and in some places becomes an argillaceous sand, and has a general thickness of about 5 feet. It disappears before the limestone rocks are reached to the east. Its eastern edge runs through eastern Hardeman and Madison and western Henry and Carroll counties.

#### RECENT DEPOSITS.

##### ALLUVIUM.

*Extent*—Between the Mississippi River and the bluffs, which form its eastern boundary, there is a flood plain, composed of alluvium deposits. This plain is from 2 to 8 miles wide on the Mississippi. Its main tributaries, the Hatchie, Forked Deer and Obion, have similar valleys of alluvium deposits, which are 1 to 2 miles wide. They are composed of sands and silts brought down by the rivers and deposited on its flood plains, which were carved out of the older formations.

#### CLAYS OF THE AREA.

##### DEFINITION OF CLAYS OF AREA.

*Kaolin*—This is a clay which approaches most nearly the mineral kaolinite in composition. It is usually formed from the decomposition of feldspars; but the few bands of from 1 to 12 inches thick which are found in West Tennessee, must be derived from the chert of the nearby Paleozoic limestone, as there are no feldspars in this neighborhood from which they might have had their origin. The only kaolin seen, was a layer several inches thick, found among the clays in the pit of the Henry Clay Company, near Henry, Henry County, although it occurs in several other places.

*Ball clay*—Ball clays are those that have a high degree of plasticity, are white after burning, and are of sedimentary origin. They are used on account of their high plasticity as a bond in mixtures of nonplastic clays in the manufacture of white ware. Their tensile strength should be good, and they should be tough and waxy. They should be free or practically so, from iron and grit. Their fusibility varies greatly, having a wide range, but refractoriness is to be desired. Those found in West Tennessee generally burn to a dense vitrified body at cone 8 or 9 and show a shrinkage around 15 per cent. They differ from the English ball clays in only having 1 to 2 per cent felspathic matter, while the English contain 15 per cent to 20 per cent. Like the English clays, they have a vitreous fracture. These clays are sometimes washed before being used. Outside of Tennessee other important deposits of ball clay occur at Edgar, Florida; Woodbridge, New Jersey, and Mayfield, Ky.

*Sagger clay*—The sagger clays of this region are generally gotten from the edges and top of the ball clay pits, where the impurities in the ball clay unfit it for use as such. A sagger clay is so called as it is used to make the receptacles called saggars in which the better grades of ware are enclosed before burning. On this account they should be very plastic and tough, and have little shrinkage, so as to hold together without cracking. They should also be refractory. The raw clay is often mixed with a crushed burnt clay, in the manufacture of the saggars.

*Wad*—Wad clay is very much like sagger clay, but does not have to be as tough or plastic. It is used for various purposes; for an example, to make a band around the top of a sagger on which another sagger is superimposed. The best wad found in West Tennessee is in Henry County. This wad will not "spit" or "fly," nor will it stick to the saggars.

*Potters clay*—Clays of this class must have good plasticity. This is necessary in order for the clay to be molded and to retain its shape until the clay is dried and burned.

The following are the properties required in a potters clay, as given by Wheeler:

- (1) Eminently plastic, (2) free from coarse sand or other coarse foreign matter, (3) as free from iron as possible, (4) capable of burning to a close incipiently vitrified body at a temperature less than 2200° F., (5) should have a range of at least 200° between the point of incipient and complete vitrification, (6) capable of frying and heating at moderate speed without the employment of grog, (7) tough and

strong body when burned, (8) free from carbonate, sulphates or other salts that are liable to cause blisters in burning.

All of the potters clays found in West Tennessee are along the eastern outcrop of the LaGrange formation, and the western edge of the Ripley sands. Pits are located near McKenzie, Hico, Toone, Pinson and Grand Junction in the LaGrange formation; and at Hollow Rock in the Ripley beds. The potters clay in West Tennessee is commonly used in the manufacture of crocks, churns, jugs, jars, dishes, flower pots, and similar wares.

*Common brick*—These clays must have sufficient plasticity to be easily molded. Their shrinkage in drying and burning must be low, so that little ware will be lost from warping or cracking. They vary widely, but are usually an impure sandy clay. On account of the amount of iron present they burn to a red color. They should burn to a dense hard body at a low temperature. A high temperature would make them fuse on account of the amount of fluxing matter present. This would prevent them being used for vitrified ware like sewer pipes, etc. The chemical composition except in a wide range is not of a very much importance, but the physical properties will greatly help in determining the methods to be used in manufacturing the brick.

*Colors*—As mentioned, iron gives a red color to the brick, while lime or magnesia gives cream or buff colors, when present in considerable quantities. The best results are obtained with from 5 per cent to 7% ferric oxide.\* Such bricks when underburned have a salmon color, which, on being well burned, becomes red, and on being overburned takes on a reddish purple or black color. Red burning clays are in greatest use for brick making, because they are more common, and also since they generally burn to a dense body at a low temperature.

The common bricks of West Tennessee are made from the surface strippings of the Ripley, Lafayette and Columbia formations, according to which covers the surface at the place of manufacture. Of these beds, the bricks made from the Lafayette should be the best, as these deposits have the best physical properties, but at present more bricks are made from the Columbia loess.

*Drainage tile clay*—The clays used for drainage tile are similar to those used for common brick. Any plastic clay that will burn to a porous body, that will dry without cracking and that has a fair degree of strength, can be used for such a purpose. A very plastic or sandy clay should be avoided as the former will check and the latter be too weak.

\*Reis, U. S. Geol. Surv. Prof. Paper No. 11, p. 45.

At present there is only one plant in West Tennessee which manufactures only drain tiles. This is located at Union City, in Obion County, the clay that is used being the dark layer of the Columbia loess. There is any amount of this clay available for such use in all the counties along the Mississippi River, while in the counties further east the same beds of the Lafayette and Ripley formations that are used for brick could be used for tile. The demand for drain tiles has, up to the present, been limited, but with the formation of drainage districts, which has recently been commenced, a great demand for them should come into existence. This industry should therefore at the present time offer a good field for investments.

*Fire brick clay*—Most good fire bricks are made from mixtures of plastic and non-plastic clays which are very refractory, but sometimes you will find a natural mixture that will give the required result. A fire brick clay must have the power to resist high temperature, a high physical strength, a loose, porous texture to permit of rapid absorption and radiation of heat, and a small amount of shrinkage. The best fire brick clays in West Tennessee come from clay lenses which occur in the lower part of the LaGrange formation, along its eastern outcrop, in Henry, Carroll, Madison and Hardeman counties. Plants are located at Puryear, Henry County, and at Gilmore, Madison County. There are many other places, where deposits were seen in the LaGrange, as well as in the Ripley formations, which could be utilized to make good fire brick.

Such a clay should not fuse under cone 27, while the best fire clays fuse at cone 35. Of the seven samples, which were sent to Heinrich Ries, of Cornell School of Ceramics (p. 30), six of them fused at cone 27 or over. The highest point reached was cone 30 in two samples, one from near Cottage Grove, the other from a road exposure 3 miles north of Milan. The former very fine-grained, and has a total shrinkage of 5 per cent, and a good bonding power, while the latter is coarser grained, has no shrinkage, and bonding power, which does not seem strong.

According to the conditions under which a fire brick is to be used, they must have different properties. For abrasive resistance they must be hard; for corrosion, dense; while to resist high heats and changes of temperature, porosity and coarseness are important.

Impure fire clays have been used in other States for sewer pipes. They make a good light-colored article, but it does not sell as readily as the dark-colored ones. This can be remedied by mixing a considerable amount of iron with the clay. A plant of this kind could be profitably operated in this part of the State, as no sewer pipe is made there now.

## MIXTURES OF CLAYS USED IN CERTAIN MANUFACTURED WARES.

*Electrical Ware*—In manufacturing this ware a mixture of ball clay, kaolin, feldspar and quartz is used. The West Tennessee ball clays, which vitrify at cone 8 or 9, are used for this ware. Refractory substances are mixed with this, so as to raise the point of vitrification to cone 12, which is considered the best temperature.

*Porcelain or china*—This is made of a mixture of clays and minerals. Porcelains are divided into two groups, those of soft body, and those of hard body, with vitrious fracture. In the soft ware calcined bones or lime phosphate is used as one of the ingredients, while in the other ware feldspar is used as flux. The other ingredients in both groups are ball clays, kaolins and quartz. Ball clays from Henry County are used in ware of this class.

*White ware*—This is made of the same mixtures as porcelain, the only difference being that the porcelain is burned at a higher temperature.

*Sanitary ware*—Ingredients and manufacture is practically the same as for white ware.

*Stoneware*—In this ware the clay is used by itself, just as it is taken from the pit. The clay is tempered, and the ware is molded on a potters wheel or in plaster of paris molds. The ware is then, after drying, glazed with a slip clay. A clay that produces a brown glaze, which is gotten from Albany, New York, is most commonly used. The articles are dipped in the liquid clay. One firing only is required, as the body of the ware gains the required hardness at the fusing temperature of the glaze. The temperature of the kiln varies from cone 6 to 9. Clays of this class are abundant in West Tennessee. (See p. 19.)

## CHARACTER OF DEPOSITS.

The clay deposits of West Tennessee are all of sedimentary origin and are gotten from the decomposition of the chert in the nearby Paleozoic limestones. The sedimentary clays are generally classified according to the conditions under which they were formed. The following conditions of deposit are found in West Tennessee:

1. Embayment (Fresh water) clays.  
Embayment (Brackish) clays  
Embayment (Marine) clays.
2. Glacial clays.
3. Lacustrine clays.
4. Floodplain and terrace clays.

*Embayment clays*—All the best deposits of this region come under this general head. They are divided into three divisions, according to

the conditions of the water by which they are laid down. The streams carrying sediments empty into these embayments and the sediments are deposited near the shore line as bars running parallel with the shore\*

These bars form the clay lenses as we find them at present. These lenses are longer than wide, and in Henry and Carroll counties the deposits which have been worked extend about 20 degrees west of north; while further south in Madison and Hardeman counties the lenses extend 15 to 25 degrees east of north. These deposits cover from 3 to 12 acres in extent, and the land over them is generally level, and often observed forming a flat area which extends several rods beyond the clay to the northwest. The signs which as a rule indicate clay deposits are a sandy top soil which is always moist and hillside springs. No boring has been done except where clay "blossoms" have already been found.

*Deposits in fresh water*—The embayment deposits laid down under fresh water conditions were the Ripley of the Cretaceous period and the Lafayette of the Pliocene period. Of these two deposits we find the best clay in the Ripley, where it is gotten from elliptical lenses, covering several acres in extent. It consists of ball, sagger, potter and fire clay, which are mined especially east of Paris and around Hollow Rock. The clays of the Lafayette are not found in lenses, and none of them are white. Only the surface layers down to 6 feet are used to make common brick. The red clays are used wherever the demand is sufficient or the railroad rates favorable for shipping. These clays

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\*While mud laden fresh water coming into the sea will often deposit the mud as a bar along the belt where the fresh waters ride on to the heavier salt water, the frequent presence of leaves in these clays, entirely unbroken and unworn, indicate that the trees must have grown close to the point of the deposition of the clay, so near that the leaves could be carried by the wind and dropped into the water where the clay was accumulating. It would therefore seem possible that the clays accumulated in lagoons, or basins, on the shore formed by the irregular action of the waves, or in the irregularities of a subsiding surface, which being in the nature of pools or ponds soon filled with mud from the surrounding surface, and were later buried beneath sand deposits laid down on the encroaching shore. For the purposes of this report detailed studies of the nature and origin of these clay lenses were not made. But the close resemblance between the succession of strata in the pits being worked, and the filled glacial lakes of the northern United States and the basal coal beds of the eastern coal fields is of interest. In each case a depression or basin has first more or less filled with clay, and then been succeeded by vegetable growth, resulting in the coal beds of the Carboniferous, in the peat marshes of the lake region, and in black clay or lignite, which in so many of the pits overlies the clay.—G. H. A.

furnish all the bricks that are made in the central counties, as Fayette, Haywood, Crockett, Gibson and Weakley, and the counties east of them.

*Deposited in brackish water*—The best and most extensive clays were deposited under these conditions, being those that are contained in the Eutaw sands are of Cretaceous age and the LaGrange sands are of the Eocene. It is in the LaGrange that most of the large pits of West Tennessee are located.

In West Tennessee during the deposition of the LaGrange beds, the waters were very shallow. The presence of strong shore currents, in places, has ruined the commercial value of many of the clay lenses, by causing such a rapid variation of the clay that no two yards are alike. Often leaves and other organic matter mined occurs in the clay, which gives it a dark brown or black color. When this organic matter can be burned out, it does not effect the value of the clay, but often when the quantity is large, the clay will burn to a buff instead of white color. Another impurity is iron, which when found in sufficient quantities renders a ball clay worthless, except for use in saggars; but a white clay that has a light pink tint is generally all right, for that will disappear in the burning, and leave a white product. Grit is another impurity, which renders a fine clay useless unless it is washed, and it is found on the edges and at the top of the deposit. On this account samples of clay should always be taken from near the bottom and as far in the hill as possible. Even then the clay, when mined, should be expected to run purer further into the deposit. These clay lenses cover from 3 to 10 acres and have a thickness at their center of about 5 to 10 feet which thins out towards the edge.

The principal pits in the LaGrange formation are in Henry County around Paris, while pottery pits are located near McKenzie, Hico, Toone, Pinson and Grand Junction.

No deposits of clay in the Eutaw are known to be of commercial value, on account of their small extent and changing conditions.

*Deposits under marine conditions*—At present no clays are used from the Selma or Porter's Creek formation. The Selma might make a good common brick or drainage tile, but on account of its outcrop being away from any railroad it has not been used.

The Porter's Creek formation has not been found to contain clay lenses of workable size. From the character of this "soapstone," as it is called, it would seem that a good paving brick could be made. Tests along this line would probably show this to be the case.

*Glacial clays*—Under this term is included the loess of the Columbia formation, which, whether deposited under water or by air, was made from the materials brought down into southern Illinois by the glaciers.

This loess is used for making common and pressed brick, and drainage tile, and is of two varieties—the light, porous material which is not very plastic, and the darker, which is denser and very plastic, out of which the tiles are made. The loess is in a continuous bed extending back from the Mississippi River bluffs, which are composed of it, and is mined wherever there is a local demand for brick, or where the railroad rates are cheap enough to ship the made articles. It is only mined down 5 or 6 feet, as below that it becomes too tough to be worked.

The loess is used in the following counties: Shelby, Tipton, Lauderdale, Dyer, Obion and in the western parts of Weakley, Gibson, Crockett, Haywood and Fayette.

3 *Lacustrine clays*—No deposits of this kind are found in West Tennessee.

4 *Floodplain and terrace clays*—The floodplain and terrace deposits are not generally used, but they have been worked for brick in a few places, where they are convenient. They are only found along the Mississippi River, and a short distance up its main tributaries, such as the Obion, Forked Deer, Hatchie and Wolf, where it forms their floodplains.

#### STRATIGRAPHIC POSITION OF DEPOSITS.

*Eutaw sands*—So far no beds or lenses of clay have been worked in the Eutaw. All through these deposits are thin layers of clay, alternating with sand. In many places a pure clay will be found, but in several feet it will grade to a pure sand. On this account these beds will probably never be of economic value.

*Selma clays*—This deposit is composed primarily of clays, which in places becomes sandy, but no pure sands are found. This clay contains a considerable amount of lime, and on this account is not worked for brick.

*Ripley formation*—There are only two places where pits in this deposit are worked, one near India, in Henry County, the other just east of Hollow Rock, in Carroll County. The pits at both places are situated near the contact of the Ripley with the overlying Porter's Creek formation, thus making the known clay deposits occur in the very uppermost part of the Ripley beds. At two other places were small non-workable deposits found; around Lexington, where they were small and sandy, and at Selmer, where a band of dark leaden grey clay one foot thick was found in spots. These two places are situated where the base of the Ripley outcrops and indicate that no good clay lenses occur in the base of the formation. It may be that clay is only found in the Ripley beds in the northern half of the State in its upper part;

and that none exists in any part of this formation in the southern half of the State in workable quantities. Still it seems that any prospecting done along its western outcrop from Hollow Rock south to the State line would, in some places, disclose workable clay lenses.

*Porter's Creek formation*—No beds or pockets of clay that are worked are found in the formation. The upper part of this formation is composed of a bed of dark grey clay, which might be worked for fireproofing. No fireproofing tiles are made in West Tennessee, but a good market for such could be found.

The following analyses of the Ripley and Porter's Creek formations will give an idea of their chemical character. They have been taken from reports of the Kentucky and Mississippi Geological Surveys. In Kentucky the Porter's Creek clay came from Paris Bridge, Murray, and the Ripley clay from 6 miles east of Murrey-Jobes and Willoughby. In Mississippi the Porter's Creek clay came from Oktibbehe County, and the Ripley from Ripley, Miss.:

*Table of analyses of Porter's Creek and Ripley formations.*

|                              | Porter's Creek |            | Ripley   |            |
|------------------------------|----------------|------------|----------|------------|
|                              | 1<br>Ky.       | 2<br>Miss. | 1<br>Ky. | 2<br>Miss. |
| Silica .....                 | 66.38          | 65.60      | 54.14    | 67.10      |
| Alumina .....                | 16.48          | 10.50      | 32.14    | 10.96      |
| Iron Peroxide .....          | 3.5            | 7.20       | 1.04     | 6.60       |
| Lime .....                   | .213           | 1.12       | .011     | 1.87       |
| Magnesia .....               | .497           | .60        | .032     | .54        |
| Potash .....                 | .928           |            | .965     |            |
| Soda .....                   | .228           |            | .468     |            |
| Water, expelled 380° F ..... | 11.774         |            | 11.204   |            |
| Volatile Matter (Co) .....   |                | 9.05       |          | 3.96       |
| Moisture (H O) .....         |                | 4.95       |          | 8.23       |
| Sulphur trioxide .....       |                |            |          | .51        |
|                              | 100.00         | 99.98      | 100.00   | 99.77      |

*LaGrange formation*—The deposits of this formation all occur in its beds, which are near the surface only at its eastern outcrop in Henry, Carroll, Madison and Hardeman counties. Further west the lower part of the LaGrange formation is too deep to permit profitable working of the clay deposits which we still find evidences of in deep well borings. All the deposits which are now worked occur within 15 miles of its eastern outcrop. No surface blossoms were found west of that. As before noted, many of the deposits are elliptical in shape, and in the northern half of the State extend a few degrees west of north, while in the southern half the longer axis lies several degrees east of north. (For location of pits, see page 27.)

(1) Kentucky Geological Survey Bull. No. 6, p. 104.

(2) Mississippi Geological Survey Bull. No. 1, pp. 159-60

*Lafayette formation*—The only clays used from this formation are the surface ones, which extend over the country as a bedded deposit, sandy in places. They are mined anywhere that the conditions are favorable. Only the upper four to ten feet can be used for brick, as below that the clays become too tough.

*Columbia formation*—Only the light and dark loess deposits, which cover the western part of West Tennessee as a surface deposit, are used in brick and the tile making. These beds can only be used from the surface to a depth of from 4 to 12 feet, according to local conditions, as they become too tough deeper down.

#### GENERAL DISTRIBUTION OF DEPOSITS.

Only the formation which contain lenses or beds of clay which are now utilized in an economic way will be discussed under this heading.

*Ripley formation*—At present only two areas contain pits of any importance in this formation. Near India, which is 5 miles northeast of Paris, Henry County, there are two pits operated, which are owned by the Mandle-Sant Clay Company, of St. Louis, Mo. The other place is around the town of Hollow Rock, Carroll County, on the Nashville, Chattanooga & St. Louis Railway. West of town are 3 pits, about one-half mile apart, and also south of town there is one pit. They ship all the clay mined to potteries located in Nashville, Tenn. Outside of these two localities no deposits are worked in the Ripley formation.

*LaGrange formation*—Pits are located in this formation in Henry, Carroll, Madison, Gibson, Hardeman and Fayette counties. In Henry County they occur along the State line to within about 6 miles of McKenzie, the best pits being located near Whitlock and Henry. More clay is mined in this county than all the rest of West Tennessee. Carroll County has a few pits located near Hico, which are not now worked. Several good outcrops were found about 4 miles west of Trezevant. No clay is mined in this county for anything except brick. Madison County has pits worked at Gilmore for fire brick and at Pinson for potters clay. A pottery is located there. Gibson County has some good deposits of fire clay located along the railroad near Milan and Humboldt, but none of them are worked. Hardeman County has pits and potteries located at Toone, in the northern, and at Grand Junction, in the southern part, where there are several old pits located. At Bolivar on the West Tennessee Asylum land, a good outcrop of very plastic clay was found. On the Southern Railway, about 3 miles east of Moscow, in Fayette County, there is a large lens which should make a good fire brick.

The best clay is found in Henry County where there are several mines of very fine ball clay, which is shipped to Kentucky, Ohio, New York and Connecticut. Clay has been gotten from near Trezevant in Carroll County, and near Bolivar, which seems to correspond very nearly to the Henry County ball clay, but no tests have been made of them.

*Lafayette formation*—This surface formation is used in the manufacture of brick at nearly all of the towns in West Tennessee, where it is overlaid. The following places have good size plants located at them: McKenzie, Milan, Humboldt, Brownsville, Trenton, Somerville, Whiteville, Bolivar and Jackson. It is only used in the central counties, for further west it is overlaid by the Columbia formation, which is there used for the same purpose.

*Columbia formation*—In the western counties where this is the surface formation, the loess is used in the manufacture of bricks. The following counties make brick from this formation: Shelby, Tipton, Lauderdale, Dyer and Weakley counties. At Union City, the only tile plant in that part of the State makes their product from these clays, while brick plants are located at Union City, Martin, Rives, Obion, Dyersburg, Covington and Memphis.

*Resume*—Any place in West Tennessee has surface clays suitable for brick making, while the fine white plastic clays occur in two belts, the principal one extending across the State from Paris in the north to Grand Junction in the South; the other and smaller band extends from India, 5 miles east of Paris, to Lexington on the south.

#### TESTS ON SHRINKAGE, FUSIBILITY AND COLOR OF WEST TENNESSEE CLAYS.

All of the following tests were made from unworked clay deposits, most of which were situated in the LaGrange formation. Typical samples of clay taken from the Porter's Creek, Ripley, Selma and Eutaw formations were also tested, from which a general idea may be gotten of the character of these clays.

*Methods employed in making the tests*—The clay was ground up very fine on an iron slab, then mixed with just enough water to work it to a plastic condition, the working being done by hand. It was then pressed in a small mold. The mold consisted of a steel ring 5.05 centimeters in diameter and .5 centimeters thick, which was broken on one side, and held in a clamp. To fill the mold it was placed on a plaster of paris block, pressed full of clay and smoothed off on top by running a steel spatula over the top of the ring. The moisture was absorbed

by the plaster of paris, the clamp loosened and the mold removed. The clay was air-dried over night, and the air shrinkage measured.

The burning was done in a Seger furnace, in which the highest temperature that could be gotten was of cone 15, which was reached after a five-hour burn.

The tests are given under the headings of the counties from which they were gotten:

| LOCALITY                                     | Air Shrink.<br>% | Total Shrink.<br>% | Color          | Temp. of burn.<br>Fahr. | Probable use       |
|----------------------------------------------|------------------|--------------------|----------------|-------------------------|--------------------|
| <b>CARROLL COUNTY.</b>                       |                  |                    |                |                         |                    |
| Old mine, near Hico .....                    | a 3½             | 10                 | White .....    | 2390°                   | Stoneware          |
| 4 mi. S. of Huntingdon .....                 | b 4              | 14½                | Dark grey ...  | *2500°                  | Stoneware          |
| 2 mi. S. of McMoresville.....                | c 3½             | 6                  | Buff .....     | 2450°                   | Fire brick         |
| 1½ mi. W. of Trezevant .....                 | a 4½             | 10                 | Light cream..  | 2335°                   | Stoneware          |
| 4 mi. W. of Trezevant<br>(J. O. Smith) ..... | b 6              | 8½                 | Light cream..  | 2460°                   | Fire brick         |
| 4 mi. W. of Trezevant<br>(Wm. Watkins) ..... | a 4              | 16                 | Light grey ... | *2335°                  | Ball clay          |
| 4½ mi. E. of Trezevant .....                 | a 4½             | 14                 | Dark grey....  | *2335°                  | Sagger clay        |
| <b>DECATUR COUNTY.</b>                       |                  |                    |                |                         |                    |
| ½ mi. E. of Parsons .....                    | b 3½             | 7                  | Dark brown..   | *2426°                  | None               |
| <b>FAYETTE COUNTY.</b>                       |                  |                    |                |                         |                    |
| 1½ mi. N. of Grand Junction..                | a 7½             | 14½                | Greyish brown  | 2282°                   | Stoneware          |
| Davenport pit, LaGrange.....                 | a 4½             | 12                 | Buff .....     | *2318°                  | Sewer pipe         |
| 2 mi. E. of Moscow on Ry. ....               | b 4              | 10                 | Dark cream ..  | *2600°                  | Fire brick         |
| <b>GIBSON COUNTY.</b>                        |                  |                    |                |                         |                    |
| 2 mi. E. of Humboldt .....                   | a 5              | 10                 | Light cream..  | 2282°                   | Stoneware          |
| 1 mi. S. W. of Milan .....                   | b 5½             | 10                 | Light cream..  | 2426°                   | Stoneware          |
| 1½ mi. S. W. Milan .....                     | c 3              | 3½                 | Dark cream ..  | 2500°                   | Fire brick         |
| 3 mi. W. Milan .....                         | b 4½             | 11½                | White .....    | 2426°                   | Stoneware          |
| 3 mi. N. Milan .....                         | c 0              | 0                  | White .....    | 2606°                   | None (mostly sand) |
| <b>HARDEMAN COUNTY.</b>                      |                  |                    |                |                         |                    |
| At Bolivar Asylum .....                      | a 5½             | 16                 | Light grey ..  | *2335°                  | Ball clay          |
| <b>HENDERSON COUNTY.</b>                     |                  |                    |                |                         |                    |
| 3 mi. W. Lexington<br>(Sanford) .....        | b 6½             | 11                 | Light grey ..  | *2390°                  | Stoneware          |
| Road exposure at Scott's Hill                | b 6½             | 7                  | Buff .....     | 2282°                   | Fireproofing       |
| Same mixed, half sawdust.....                | c 2              | 12½                | Buff .....     | 2370°                   | Fireproofing       |
| <b>HENRY COUNTY.</b>                         |                  |                    |                |                         |                    |
| ½ mi. N. of Cottage Grove....                | c 1½             | 4                  | White .....    | 2606°                   | Fire brick         |
| Porter's Creek clay, ¼ mi.<br>S. Paris ..... | c 2              | 6½                 | Light cream..  | 2370°                   | Fireproofing       |
| Ripley clay, 3 mi. E. Paris....              | c 5              | 10½                | Light cream..  | 2370°                   | Brick              |
| ½ mi. S. W. Mandle pit No. 7..               | a 3              | 8½                 | Light cream..  | 2425°                   | Sagger             |
| <b>MADISON COUNTY.</b>                       |                  |                    |                |                         |                    |
| Brown Church Road, Jackson..                 | a 6              | 18                 | Light cream..  | 2425°                   | Ball clay          |
| Spring Creek Road, Jackson....               | c 3½             | 6                  | Light cream..  | 2500°                   | Brick              |
| Spring Creek Road by bridge .                | c 7½             | 14½                | Cream, speck'd | *2425°                  | Brick              |
| 1½ mi. E. Malesus .....                      | b 3              | 11                 | Light grey ... | 2282°                   | Stoneware          |
| 1 mi. W. of Medon .....                      | c 5              | 14                 | Light grey ... | *2600°                  | Fire clay          |
| 2½ mi. S. Medon .....                        | c 4              | 12                 | Light cream..  | 2335°                   | Fire brick         |
| Same, Bolivar Road .....                     | b 4½             | 10                 | Creamy grey..  | *2600°                  | Fire brick         |
| Davis pit, near Pinson .....                 | b 6½             | 12                 | Light cream..  | 2390°                   | Stoneware          |
| Allen pit, near Pinson .....                 | b 8½             | 11½                | Buff .....     | *2318°                  | Stoneware          |

a—very plastic. b—plastic. c—slightly plastic. \*—slightly vitrified.

Seven of the preceding samples which contained clay, which seemed especially adapted to making a good fire brick, were sent to Heinrich Ries of the Cornell School of Ceramics to be tested for their fusibility.

In making these high temperature tests the clay is made into small cones identical in shape and size to the Seger cones. The following results were gotten:

| CARROLL COUNTY.                            | Cone of Fusion | Temperature Fahr. |
|--------------------------------------------|----------------|-------------------|
| 2 miles south of McLemoresville .....      | 26             | 3002°             |
| 4 miles west of Trezevant (J. B. Smith) .. | 29             | 3110°             |
| FAYETTE COUNTY.                            |                |                   |
| 2 miles east of Moscow on railroad .....   | 27             | 3038°             |
| GIBSON COUNTY.                             |                |                   |
| 1½ miles southwest of Milan .....          | 27             | 3038°             |
| 3 miles north of Milan .....               | 30             | 3146°             |
| HENRY COUNTY.                              |                |                   |
| ½ mile north of Cottage Grove .....        | 30             | 3146°             |
| MADISON COUNTY.                            |                |                   |
| 2½ miles south of Medon .....              | 27             | 3038°             |

#### MINING, PREPARATION AND MANUFACTURE.

As this Survey intends to make a clay report of the three divisions of the State, no exhaustive discussion of the technology of clays will be given in this, the first bulletin of the three. Only enough of the technology will be given to allow of a complete understanding of the few technical terms used herein.

#### MINING.

*Brick clay*—These clays are mined in most cases directly from the surface down until they become too tough to be molded by the machine, which depth varies in the Lafayette clay from 4 to 10 feet, while in the Columbia formation, the loess is as a rule worked down to about 5 feet, though some cases were heard of where it was said to be mined to a depth of 15 feet. In certain places a foot or two of the surface clays are thrown aside. The grey clays which are used in brick manufacturing are found in lenses from which the overburden has to be removed by iron scrapers. The brick clays are usually dug with a pick and taken to the nearby machine or the storage sheds by iron scrapers, such as are commonly used for grading.

*Potters clay*—The white, grey and pink plastic clays all occur in lenses covered by an overburden which varies from 2 to 30 feet, which is removed by iron scrapers, or steam shovels, according to the policy of the operating company. In most cases the scraping method is declared to be the most economical. The clay itself is blasted to loosen it, and then dug out with picks and spades.

For hauling the clay some of the pits have narrow gauge roads running down in them, which connect with the railroad. The clay in such cases is loaded into small dump cars, which are carried by "Dinkies" to the railroad, where it is piled in sheds, awaiting its loading and shipping over the railroad. Where narrow gauge roads are not used the clay is hauled out of the pit in two-horse wagons, to a nearby railroad switch, where it is loaded or stored in sheds.

#### GRINDING.

The dry pan and ball mill are the pulverizers most commonly employed, but in West Tennessee no ball mills are used, and only a few dry pans, which are used in connection with dry press brick machines.

*Dry pan*—This machine consists of a revolving metal pan, over the bottom of which roll two heavy wheels or mullers. The central part of the pan is solid, and over this the mullers roll, while the outer side of the bottom of the pan is perforated, and over it the crushed clay is spread by centrifugal force. The small particles sift through, while the large ones are thrown back in front of the mullers by means of scrapers. The pans vary from 5 to 9 feet in diameter, and are about 14 inches high. Screens may be had with either large or small perforations. Dry pans made by the Frost Manufacturing Company, Galesburg, Ill., are in use.

#### CONVEYERS.

Conveyers are used for carrying the mud from the soaking pits to the brick machines, or to carry the dry pulverized clay from the dry pan to screens, where it is sifted, before falling into the top of the dry press brick machine.

The conveyor may be a belt or rubber apron with flanges on the side to prevent the clay from falling off. Where the conveyor has a steep inclination, cross pieces may be added, and when vertical a series of iron buckets fastened to a chain or belt are used.

#### SCREENS.

The clay that comes from the dry pan is not uniform enough in size to be passed directly to the dry press machine. The grading is accomplished by screens which return all clay larger than a certain size to be reground.

The screens are made with various size openings, or have different meshes—according to what size particles must pass through them. Screens are made in three general types: inclined stationary, inclined vibrating and rotary.

## TEMPERING.

The crushing methods that have been mentioned are used with dry clays, with the object of reducing them to uniform size. The tempering, as it is called, is necessary to develop the plasticity of the clay, and is accomplished by mixing the clay with water, and making the entire mass have a uniform composition. The process may be accomplished several different ways.

*Soaking pits*—In making soft mud bricks the clay is put into pits, usually 4 feet deep, and holding enough mud to make 20,000 brick. It is then mixed with water and kept in the soaking pits for 24 hours.

*Wet pan*—It is constructed very similar to the dry pan, except that the bottom is solid instead of perforated. It is used in West Tennessee to both pulverize and temper the clay used in potteries. The clay is shoveled into the pans, and water added to bring it to the proper consistency. It is then thoroughly ground and mixed. The tempered clay is removed—by means of a long-handled shovel mounted on a pivot near the pan—while the machine is in motion, after which another charge is added and the operation repeated. The wet pan is smaller than the dry, but it performs the two operations of grinding and tempering together. A wet pan manufactured by Turner, Vaughn, Taylor & Co., Cuyahoga Falls, Ohio, is used in some of the potteries.

*Pug mill*—It is used primarily with brick clays in the manufacture of which it is used very extensively.

The pug mill consists of a semi-cylindrical trough of steel, having a length of from 3 to 16 feet, with an average of 8 feet. Through this a shaft revolves, which has a series of knives set spirally on it, and at an angle to its plane of revolution. The angle of the knives and the rate of revolution determines the rate at which the clay will be carried forward. Its discharge is regulated by a movable gate. The mill is usually made horizontal, and either as a part of the brick machine or separate from it.

In places, home-made wooden vertical pug mills, which are turned by a horse, are used in making soft mud brick. The shaft is a small tree with wooden bars sticking out at right angles, while the casing for the shaft is square and made of rough boards.

The clay is fed into the hopper of the pug mill and sufficient water added to bring to the right consistency for molding. This must be done by an experienced man, for if too little water is added the clay bar will be cracked as it comes from the machine, or if too much water is added the brick will be so soft that it will be easily injured in handling, as well as taking long time to dry, and having more shrinkage than proper.

The following makes were seen in use: Eagle Soft Mud Brick Machine, R. Craycroft, Vandalia, Ill.; Iron Standard Brick Machine, No. 289, Horton Mfg. Co., Painesville, Ohio; Success Soft Mud Machine, Success Brick Mfg. Company, Memphis, Tenn.; No. 24-SSS Stiffmud Brick Machine, Arnold-Creager Co., New London, Ohio; No. 3 Stiff Mud, J. C. Steele, Statesville, N. C.; Hercules Soft Mud Machine, Horton Mfg. Company, Raymond, Ohio; J. D. Fate Machine No. 9 A Stiff Mud, H. Brewer & Co., Tecumseh, Mich.; Soft Mud Machine, Hardin Mfg. Company, and Grand Automatic Soft Mud, John Creiger.

*Chaser mills*—These mills are used in several brick plants where hand molding is used. They consist of a circular pit, about 18 inches deep, and about 18 feet in diameter, in which revolves a frame bearing two narrow iron wheels, 30 to 36 inches in diameter. As this frame revolves, the wheels by means of gearing travel from the center to the circumference of the pan and back again. The clay and water is placed in the pan, and the wheels grind and temper it. A wheel manufactured by C. W. Raymond, Dayton, Ohio, is the one commonly used.

#### MOLDING.

There are two processes used in the molding of brick, the wet method, where water is mixed with the clay, and the dry method, where no water is used, the clay being pressed in a dry condition. The cheapest way on a small scale is hand molding, which method is employed in five plants in West Tennessee. Next in order comes the soft mud machine, which is used in ten plants, and vies in popularity with the stiff mud machine, which is used in seven different plants. The most expensive machine is the Dry Press, which is the only machine making a smooth press brick. It is in operation in five plants in West Tennessee. Most of the three different machines in use have a daily capacity of 20,000 bricks.

*Soft mud*—In this method the clay is mixed with water to the consistency of soft mud and pressed into wooden molds. The molds are sanded to prevent the clay sticking to them, and the molding is done either by hand or by machinery. In hand molding a lump of clay is forced into the mold, pressed down and the excess of clay cut off by means of a fine wire. The mold is then turned over, and the brick dumped out. In West Tenn. one molder will make 6,000 brick a day. The soft mud machine consists of an upright box in which revolves a vertical shaft with several blades, while there is a curved arm attached to the bottom of the shaft to force the clay into the press box. The mold, which has six divisions, is sanded and pushed under the press box, then the plunger descends and forces the soft clay into it, then

the mold moves forward automatically to the delivery table, while another sanded mold takes its place.

*Stiff mud*—In this method the clay is tempered with less water, and is therefore much stiffer. The process consists in taking the clay and forcing it through a rectangular die in the form of a bar, which is then cut into bricks. The "Auger" type of machine is used in West Tennessee. It consists of a cylinder open at one end and tapering to a rectangular die, with a cross section the size of the side or end of the brick. The inside of the cylinder is made like a pug mill with the addition at the small end of a tapering screw. The die is heated by steam, and oil is used on its inner side to facilitate the flow of the clay.

The tempered clay is put in the hopper and moved forward by the arms and then pushed through the die by the screw. The bar of clay runs out on a cutting table and is cut into brick by a number of parallel steel wires.

The process is good, when properly used, but the clay should be thoroughly tempered before molding.

*Dry press*—In this method the clay is ground and screened and then pressed into steel molds in a dry condition. The molding machine consists of a steel frame with a delivery table 3 feet above the ground and a press box sunk into the rear of it. The charger, which consists of a frame work which slides back and forth over the molds, is connected with the clay hopper by a canvas tube. It is filled when it moves back, at which time the plunger descends pressing down the clay in the molds, while at the same time the bottom of the mold rises slightly, subjecting the clay to greater pressure. The plunger then rises, also the mold, which ascends to the level of the delivery table. The mold is then pushed forward by the charger as it comes forward to refill the molds.

The faces of the mold are made of hard steel and heated to prevent sticking of the clay. They also have small air holes in them to prevent the escape of air, which becomes imprisoned in the clay when the plunger descends. Two machines of this class were seen in use—a Burg Dry Press, made by Anderson Foundry & Machine Works, Anderson, Ind., and a Reliance Dry Press, made by Reliance Machine & Tool Works, St. Louis, Mo.

At one place in West Tennessee an hydraulic dry press is used. In this the pressure is produced by a pair of hydraulic rams acting gently and applied from above and below.

The advantages of this process are that in one process a brick with smooth faces and sharp edges is made, also that no preliminary drying is necessary before burning, the bricks being placed directly in the kiln.

*Repress machine*—Soft and stiff mud brick are often improved in appearance by repressing. The repress consists of a steel mold box, having a movable top and bottom. The green brick are placed in it, and pressure applied. This reforms the brick slightly and makes a poor front brick.

*Turning*—This is done in the potteries of West Tennessee on a rapidly revolving horizontal wheel, called a "kicker," as it is worked by a foot pedal. The potter takes the lump of clay and places it on the rapidly revolving disc; wetting the surface with his hands he slowly and gradually works the revolving mass into the required form. The ware is detached from the wheel by running a thin wire underneath it, and is set aside to dry. Crocks, jugs and similar ware are turned.

*Repressing*—Instead of turning, the ware is often made in plaster of paris molds, made in two or three pieces, whose inner surface conforms to the outer surface of the ware.

#### DRYING.

The drying is done under outdoor racks, no plants at present being equipped with drying apparatus. This permits working only in the summer, except where dry press machines are used, for then the brick can be placed directly in the kiln without a preliminary drying. The installation of drying machinery is very expensive, and increases the cost of the brick. A sun-dried brick is therefore cheaper. The bricks are dried, according to their composition, from 2 to 8 days, 7 days being the general time taken. Those bricks made from the Lafayette clays take less time than those using the Columbia loess or loam.

#### BURNING.

*Difference in cost*—The bricks are burned in a variety of kilns, four types being in use; the scove and Dutch updraft, the continuous and the downdraft. There are thirteen plants using Dutch kilns, with a total of forty-one such kilns in operation. They reduce the amount of fuel necessary to burn brick. In one such kiln is required twenty-five hundredths of a ton of coal, fourteen hundredths of a ton of coke, and seven hundredths of a cord of wood for burning 1,000 brick, making the cost about \$1.35 per 1,000 brick for fuel.

The downdraft kilns are rectangular and beehive in shape, only one of the former kind being in use. There are seven plants using intermittent downdraft kilns, with a total of twenty-two such kilns in operation. This type of kiln reduced still more the cost of burning. In one such kiln in West Tennessee, it required twenty-three hundredths of a ton of coal, eleven hundredths of a ton of coke, and five hun-

dredths of a cord of wood per 1,000 brick, making the fuel cost about 95 cents a 1,000 brick. This shows a saving in cost of fuel of 40 cents a 1,000 brick, which is partly eaten up by the extra cost of downdraft kiln, but even then there is a great saving. No figures could be gotten on the continuous kiln, but the cost is probably slightly reduced in this type.

The coal used in the kilns in the northern part of the State is gotten from Kentucky, and in the southern part from Alabama. Tennessee coal is not used. Where patented burning systems are used, a poor coal can be gotten which costs about \$1.60 a ton delivered, but for ordinary burning the coal used costs from \$2.25 to \$3.25 a ton delivered, according to the distance hauled. Where coal only is used in burning, it requires about one-half a ton per 1,000 brick. This is the case only where a patented system of burning is used. The cost for fuel in this case is about 80 cents per thousand brick.

Coke is used only in conjunction with wood to dry out the brick before burning. It costs from \$3.75 to \$4.00 a ton delivered, and from one-tenth to one-half ton per 1,000 brick are used according to the type of kiln.

Wood is used for drying out the brick by itself or in connection with coke, or is used for both the drying and burning. It costs from \$1.25 to \$3.00 a cord delivered. In many places slabs from saw mills are used. In drying out in conjunction with coke, from one-tenth to five hundredths of a cord are used per 1,000 brick, while for drying and burning just with wood, it requires about one cord of wood per 1,000 brick.

The cheapest burn with coal, which was found in West Tennessee, was 80 cents per 1,000 brick, with wood, \$1.25 per 1,000 brick, and with a mixture of coal, coke and wood, 94 cents per 1,000 brick. The highest cost of fuel that was found in burning was \$3.28 per 1,000 brick, where they used coal, coke and wood.

*Scove kiln*—This is the simplest type of updraft kiln, and is of temporary character. In West Tennessee the brick are set in large rectangular masses about 40 bricks high. In piling up the bricks a series of parallel arches are left running through the mass from side to side, with their centers 27 inches apart. These are the fire holes and are called "eyes." The bricks are surrounded by a wall of under burned brick 13 inches at the base and 9 inches at the top, which is plastered over with wet mud. (See plate 5, Fig A.)

*Dutch kilns*—These so-called Dutch kilns are a slight improvement over the scove kilns, since they have permanent side walls, and so heat up better, and admit less cold air. They are rectangular in shape and



FIG. A. SCOVE KILN, WITH BRICK LARGELY REMOVED, PARIS, TENNESSEE.



FIG. B. TYPICAL DOWNDRAFT BEEHIVE KILN, SHOWING FINISHED BURN.  
SOUTHERN TILE AND BRICK WORKS, GILMORE, TENNESSEE.  
OLD AND NEW METHODS OF BURNING BRICK.

277/1

155

the same size as the scove kiln. The walls are about 4 feet thick at the base, and the fire holes about 8 feet long. (See plate 5, Fig. B.)

*Downdraft kilns*—These kilns are completely walled in, and are so arranged that the heat is carried to the top of the kiln by inside flues, then going down through the brick, escapes through holes in the floor. They are built either in the shape of a beehive or rectangle. The beehive kilns are about 25 feet in diameter and 8 feet to the beginning of the crown. The walls are 4 feet at the base and 2 feet at the top, and generally have 8 fire holes around the circumference at the base.

The rectangular ones are just like the Dutch kilns, except that they are roofed in, and have doors for charging and discharging.

*Continuous kilns*—The principal of this type is to utilize the waste heat from burning. It consists of a series of chambers arranged in a circle, connected with each other, and with a common stack by flues. To start, the first kiln is fired by means of exterior boxes, and while the smoke is coming off it is conducted to the stack, but as soon as this stage is passed, the heat is passed into the next chamber in succession. Thus the waste heat is utilized. When a compartment gets red hot slack coal is added through small openings in the roof, which are covered by iron caps.

It is possible in this kiln to be burning brick in one chamber while other ones are being heated up, filled and cooled.

Only one kiln of this type is in use in West Tennessee.

#### LABOR.

Where men are paid by the day the average is \$1.25, with \$2.00 for a few, who do special work. Many plants pay their men by the 1,000 brick, the following being the rate for West Tennessee:

|                      |                |
|----------------------|----------------|
| Brick molder .....   | \$ .40         |
| Mud wheelers .....   | .21 to .25     |
| Mud temperer .....   | .22½           |
| Off bearers .....    | .16 2-3 to .20 |
| Rackers .....        | .21            |
| Brick setters .....  | .12½           |
| Brick wheelers ..... | .25 to .30     |

The labor required for making and burning the brick varies from about \$1.25 up to about \$2.90 a thousand. The average cost for labor is about \$1.75 per thousand brick for either three classes of machines. The dry press machine requires less labor than the others if worked properly.

The cost of manufacturing brick in West Tennessee, leaving out wear on machinery, mining of clay and office expenses, varies from

about \$2.50 to \$4.85 a 1,000, while the selling price varies from \$5.50 to \$12.00 a thousand.

#### BRICK OUTPUT FOR 1910.

There were between sixty-two and sixty-three million bricks made in West Tennessee during 1910. Twenty-five plants were visited at the following towns: (See Plate 6.)

| Towns               | No. of Brick Made |          |
|---------------------|-------------------|----------|
| Brownsville .....   | 850,000           |          |
| Bolivar .....       | 1,000,000         |          |
| Covington .....     | 1,000,000         |          |
| Cottage Grove ..... | 200,000           |          |
| Dyersburg .....     | 3,000,000         |          |
| Gilmore .....       | 4,000,000         |          |
| Humboldt .....      | 1,000,000         |          |
| Jackson .....       | 2,000,000         |          |
| Lexington .....     | 2,000,000         |          |
| Martin .....        | 2,500,000         |          |
| McKenzie .....      | 2,000,000         |          |
| Memphis .....       | 35,500,000        | 4 plants |
| Milan .....         | 2,000,000         |          |
| Obion .....         | 400,000           |          |
| Paris .....         | 400,000           | 3 plants |
| Ripley .....        | 1,600,000         |          |
| Rives .....         | 400,000           |          |
| Scott's Hill .....  | 150,000           |          |
| Trenton .....       | 600,000           |          |
| Union City .....    | 2,000,000         |          |
| Whiteville .....    | 250,000           |          |
|                     | <hr/> 61,050,000  |          |

The towns of Middleton and Trezevant have plants, but they were not in operation in 1910, as there was no local demand for brick. In 1909, the plant at Middleton produced 200,000 brick, while at Trezevant 900,000 were made.

There are probably scattered through the counties a few other small scove kilns, which would increase the total production to nearly sixty-two million. The capacity of all the permanent kilns that are situated in West Tennessee is 18,321,000 brick. This does not include the scove kilns, which are used in seven plants. The downdraft kilns have 2,410,000 and the updraft 16,090,000 brick capacity.



FIG. A. SOUTHERN TILE AND BRICK WORKS, GILMORE, TENNESSEE.  
Showing kilns, sheds, powerhouse in background and part of pit in foreground.



FIG. B. COSTEN-MOORE & COMPANY, MCKENZIE, TENNESSEE.  
Showing drying and machine sheds and Dutch kilns.  
BRICK PLANTS OF WEST TENNESSEE.

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## CLAY OUTPUT FOR 1909.

The following tables were taken from State of Tennessee Mine Inspector's report for 1909:

*Clay mined and sold in Tennessee in 1909. Short tons.*

|              | No. of<br>Employees | Ball   | Fire  | Sagger | Stoneware | Miscel-<br>laneous | Total  |
|--------------|---------------------|--------|-------|--------|-----------|--------------------|--------|
| Hardeman ... | 7                   |        |       |        | 223       |                    | 223    |
| Henry .....  | 136                 | 16,993 | 7,122 | 940    | 1,500     | 6,080              | 33,335 |
| Madison .... | 5                   |        | 230   |        |           |                    | 230    |
| Weakley .... | 1                   |        |       |        | 15        |                    | 15     |
|              | 149                 | 16,993 | 7,352 | 940    | 1,738     | 6,080              | 33,803 |

*Products and Value.*

|                          | Product<br>Short Tons | Value    |
|--------------------------|-----------------------|----------|
| Ball clay .....          | 16,993                | \$50,735 |
| Fire clay .....          | 7,352                 | 9,847    |
| Sagger clay .....        | 940                   | 1,640    |
| Stoneware clay .....     | 1,738                 | 2,000    |
| Wad clay .....           | 6,080                 | 7,460    |
| Miscellaneous clay ..... | 700                   | 1,250    |
|                          | 33,803                | \$72,932 |

## SELLING PRICE OF BRICK AND CLAY.

The selling price of bricks vary, not on account of any great difference in cost of fuel and labor, but on account of lack of competition.

Bricks sell in the largest towns for from \$6.00 for the run of kiln up to \$16.00 for specials. In the smaller towns the prices are higher averaging \$7.00 or \$8.00 a 1,000 for common unpressed brick. In a few of the smaller towns the brick sell at as low as \$6.00 a 1,000, while, when they are shipped the prices are cut to meet competition, and often they are sold at \$5.50 f.o.b.

The ball clay shipped north brings for the best grade, prices ranging from \$3.50 to \$2.50 a ton, while sagger brings \$1.50 and wad \$1.25 a ton. All of these prices are f.o.b. shipping point.

## SELLING PRICE AND OUTPUT OF STONEWARE FOR 1909.

There are four potteries in operation in West Tennessee at present, located at Grand Junction, McKenzie, Pinson and Toone.

The ware is made on potters wheels or in molds, and then after drying it is dipped in some kind of slip, and then put in beehive kilns and burnt. The burning occupies from 12 to 70 hours, and is done by coal or wood.

The following articles are made: flower pots, chicken founts, jars, churns, pitchers, sewer pipes, cuspidors, milk pans and chambers, in

various sizes. In 1909 there were about 230,000 gallons of the foregoing ware made, which sold at from 5 to 7½ cents a gallon, f.o.b. the plant.

### CLAY RESOURCES BY COUNTIES.

#### BENTON COUNTY.

Benton County lies along the Tennessee River in northeast part of West Tennessee. The rocks outcropping here are the old Paleozoic limestone, the Ripley sands, and in the extreme south a small area of the Eutaw formation. Of these formations the Ripley is the only one which is at present worked. No clay deposits are worked in it in this county, although outcrops of a white clay have been found north of Camden. No deposits were visited in this county.

#### CARROLL COUNTY.

*Topography*—Carroll County is situated in the northeastern part of West Tennessee. In shape it is nearly square, and has an area of 624 square miles.

The Tennessee divide crosses this county, making the drainage of the county run east and west; about one-third drains into the Tennessee River and Big Sandy, and the rest into the Mississippi. The surface on either side of the divide is very hilly, and many gullies are in evidence, as erosion is active along the divide. The streams in the northern and western part of the county have broad flood plains, and the country is more level. The elevation of the divide is from 450 to 500 feet, while along the river bottoms the altitude is about 375 feet. The average elevation is near 425 feet.

*Railroads and towns*—The county seat is Huntingdon, a prosperous town, situated in the center of the county on the Nashville, Chattanooga & St. Louis Railway. Its elevation is 414 feet. The only other important town is McKenzie, situated in the northwest corner, at the junction of the Nashville, Chattanooga & St. Louis, and Louisville & Nashville railroads. This place has an elevation of 481 feet, and is the largest town in the county.

The railroads cover the county very well, two junctions being situated in it, one at Hollow Rock Junction, where two branches of the Nashville, Chattanooga & St. Louis meet, and the other at McKenzie, where a branch of the Louisville & Nashville meets the main line of the Nashville, Chattanooga & St. Louis. The Nashville, Chattanooga & St. Louis crosses the northern and eastern parts of the county, while the Louisville & Nashville runs through the western portion.

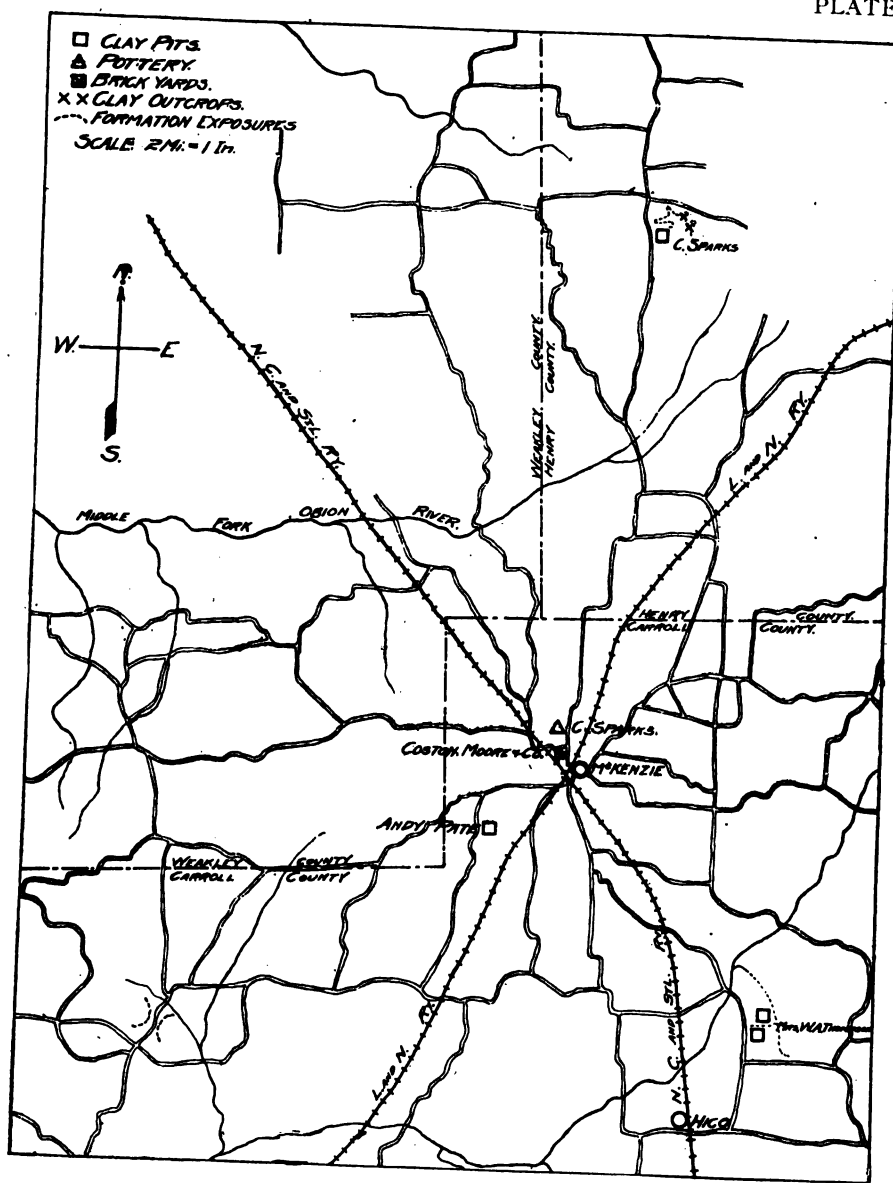
*Geology*—The Selma clay covers a few square miles in the south-east corner. West of it, and along the eastern border of the county, is a belt of Ripley sand 6 to 8 miles wide. Next to this the Porter's Creek outcrops across the county in a belt 2 miles wide, its western edge passing through Huntingdon. This leaves the whole western half of the county underlaid by the LaGrange sands and clays. The whole county is overlaid by a thin blanket of Lafayette sands.

*Clay deposits*—Most of the clay mined is shipped to Nashville to be used in the making of pottery. There are four pits located along the Nashville, Chattanooga & St. Louis Ry., west of Hollow Rock, and one south of the town. They are all in a radius of 3 miles. At Hico, just west of Hollow Rock, there are some old pits from which clay was shipped several years ago, but are now abandoned. Clays are mined for the manufacture of brick at McKenzie and Trezevant. Deposits of fire clay occur south of Huntingdon and McKenzie, and west of Trezevant. Only the deposit at McKenzie has been worked, and that has been used only for a few local brick. There is also a pottery at McKenzie. East of Trezevant is a blossom of very plastic clay, which should be tested. All the deposits around Hollow Rock are in the Ripley formation, while the rest of the pits are in the LaGrange, with the exception of the Lafayette clays, which are used for brick at McKenzie and Trezevant.

*Hico*—The old pits from which clay was taken to ship to Louisville for pottery are located in a ravine just south of the Hico schoolhouse, which is 2 miles north of Hico on the road to McKenzie. (See map of McKenzie and vicinity, page 42.) Very little information could be gotten concerning these pits, as they have not been worked for three years. They are owned by Mrs. W. A. Thomas, of Hico. There is a natural outcrop of the clay along the south bank of the small stream along the bottom and up the sides of the banks for several feet. The deposit by the shed was worked by cutting away the side of the hill on the south side of the small stream, and draining into the nearby stream. The hill has been dug back about 20 feet for a distance along the stream of 150 feet. When visited the pit was nearly filled in, and all overgrown.

The best section obtained was the following:

|                                                          | Feet |
|----------------------------------------------------------|------|
| Light orange sandy clay, no gravel .....                 | 6-15 |
| Banded yellow and white sand .....                       | 3-4  |
| Clay lens, pinkish white, exposed to stream bottom ..... | 5    |



MAP OF CLAY OUTCROPS AT MCKENZIE, CARROLL COUNTY, AND VICINITY.

Although only 5 feet of clay is exposed, the bed is several feet thicker, as the clay extends down under the stream bed. The clay is very plastic, and works well, but seems to have a small amount of grit present. It is slightly colored by the presence of a small amount of iron, which gives it a mottled pink and white color. The clay has a conchoidal fracture.

Small sand grains are scattered through the mass, as well as a small amount of organic matter, such as rootlets, etc. No concretions or boulders were found.

The clay in this pit is in the lower part of the LaGrange formation. Above it is a mantle of Lafayette sandy clay which rests unconformably upon it.

The outcrops occur at the foot of the hill, and extends all along the stream. The main stream runs east of the hill with a small stream already mentioned, which runs north of the deposit. This stream is fed by springs which come out of the clay lens. The hill extends southward from the outcrop. (See frontispiece.)

The overburden is a light sandy clay, which reaches in the center of the hill a thickness of about 30 feet. This maximum thickness of overburden is reached about 75 feet from the outcrop. The overburden is of a loose sandy nature which can be removed. The clay lens most probably also thickens in the center, so that the overburden may not be so much as it would seem from surface indications.

In regard to the accessibility of the deposit. It can be reached by a common dirt road, which crosses the Nashville, Chattanooga & St. Louis Railway inside of a mile, or the clay could be shipped from Hico, 2 miles distant. The entire hill is covered with timber, of fairly good quality, including oak, hickory and chestnut. No good supply of water is available at present, as the springs are small and weak, and the main stream west of the deposit is a dry bed most of the year. Any coal used would have to be shipped in by rail.

About 100 yards from the first pit, and nearer the Hico schoolhouse, on the east side of the road, is another old pit, identical in most respects with the other. Its section is as follows:

*Section of pit near Hico schoolhouse.*

| Lafayette:                            | Feet |
|---------------------------------------|------|
| Light orange sandy clay .....         | 20   |
| Banded white and orange sand .....    | 5    |
| LaGrange:                             |      |
| Clay white and pink to road bed ..... | 5    |

This pit has been excavated back 50 feet, and about 75 feet wide. The dry stream bed is just across the road from it, the road in places running through its bed. This pit also has filled in greatly, as it has not been worked for three years.

The following is a section of a gully at the Hico schoolhouse:

*Section at Hico schoolhouse.*

|                                                               | Feet |
|---------------------------------------------------------------|------|
| Columbia:                                                     |      |
| Light yellow .....                                            | 1    |
| Lafayette:                                                    |      |
| Dark orange case-hardened sandy clay .....                    | 10   |
| LaGrange:                                                     |      |
| White and orange cross-bedded, case-hardened sandy clay ..... | 15   |

*Hollow Rock—Bill Barnhart pit*—The pit is situated 2 miles west of Hollow Rock on the north side of the Nashville, Chattanooga & St. Louis Railway. (See map of Hollow Rock and vicinity.) The pit is owned by Bill Barnhart, of Hollow Rock.

The clay outcrop at base of hill is a small "blossom." The pit is about 100 feet wide, and extends into the hill for nearly 100 yards, and the bed has a thickness of 7 feet. The clay extends back under the rest of the hill, which covered about 10 acres.

The following is a detailed section of pit:

*Section at Barnhart pit, near Hollow Rock.*

|                                                                                                                        | Feet  |
|------------------------------------------------------------------------------------------------------------------------|-------|
| A sand, dark red, hardened at top which grades to a lighter color, and finally into a yellow sand above the clay ..... | 20-25 |
| Clay greyish yellow, slightly gritty, no nodules .....                                                                 | 7     |
| Sand fine yellowish white, extends down under clay.                                                                    |       |

The clay is colored grey by the presence of a slight amount of organic matter. Very little iron is present, only enough to give it a slight yellow tinge. The clay is of a fairly uniform color, which gets darker toward the bottom of the deposit. It has a conchoidal fracture. No analysis has been made of this clay. Leaf impressions are found in certain layers, and the whole bed is slightly gritty, but no nodules of iron or any other mineral are present. The bed is massive, without joints, or thin sand layers to break up, and clay breaks out in lumps of irregular size.

This clay as well as all the others around Hollow Rock is in the upper part of the Ripley formation. The overlying sands are of the Lafayette formation of the Pliocene age, and in all these pits forms the overburden.

This clay lies just at the base of the hill, where much water collects. This is removed by bailing, as the pits are only worked in dry weather. The overburden at the pit face is about 25 feet, and becomes heavier further back, the maximum being about 35 feet. The upper 15 feet

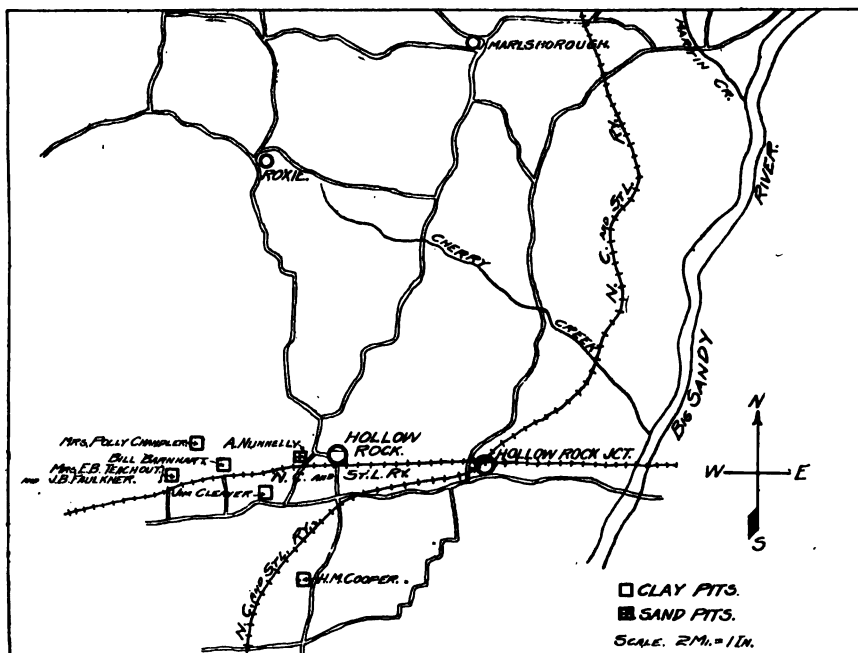


FIG. 3.

CLAY OUTCROPS AND DEVELOPMENTS NEAR HOLLOW ROCK, CARROLL COUNTY.

is very hard and difficult to remove, while lower down it is very easily removed, being a loose sand.

This pit is very accessible, as it is right on the Nashville, Chattanooga & St. Louis Railway, and only one-fourth mile from a switch where it can be loaded and shipped. The soil on top of the clay lens is covered with a light second growth of timber, most of it still small. The only water is gotten from wells, as the nearest stream is between 2 and 3 miles away. All coal is shipped from Kentucky or central and East Tennessee.

This deposit was opened ten years ago. It is worked by the open pit method, without machinery, and the clay hauled to the railroad in wagons. The area underlaid by clay has never been determined, but it is thought to underlie the whole hill. The hill extends 15 degrees west of north. The clay is used in the manufacture of pottery and stoneware, 400 tons being shipped last year to the Harley Pottery Company. Only one grade of clay is gotten here.

*Mrs. E. B. Teachout and J. B. Falkner pit*—This pit is located at the switch on the Nashville, Chattanooga and St. Louis Railway, 2

miles west of the town of Hollow Rock, on the north side of the track. It is owned at present by Mrs. E. B. Teachout and J. B. Falkner, of Hollow Rock.

The clay is 9 feet thick and is worked in open pit, 75 yards wide by 150 feet in depth.

*Section of Teachout-Falkner pit, near Hollow Rock.*

|                                                                            | Feet |
|----------------------------------------------------------------------------|------|
| Clay red sandy, case-hardened, clay pellets, and a sprinkling of gravel .. | 20   |
| Very light grey clay, nearly white .....                                   | 4    |
| Changes to a black clay in the the lower part of the bed .....             | 5    |

The fracture is conchoidal, when broken, but generally splits into layers several inches in thickness, and is very plastic. The lower 5 feet contains a large amount of carbonaceous matter, which in places unfit it for use, also leaf impressions are sometimes found. The entire bed is slightly gritty, but no nodules of sand are present. The pit could be drained into a nearby gully. The overburden here is about 20 feet thick. The land is covered with only a few small scattered trees.

The pit is beside the Nashville, Chattanooga & St. Louis Railway, having a switch and sheds; no machinery is used. Only well water is available. Clay has been shipped from here for eight years to the Harley Pottery Company, at Nashville, Tenn. In 1910, 1,200 tons were shipped.

*Mrs. Polly Chandler's pit*—This pit is no longer mined, on account of the large amount of carbonaceous matter and iron present, which keeps the clay from burning white or cream. It is located one-half mile back from the Nashville, Chattanooga & St. Louis Railway at the Teachout switch. The overburden is from 15 to 20 feet thick. Many leaf impressions are reported found in this clay. Not visited.

*Jim Cleaver pit*—This pit is situated on the north side of the Huntingdon road, one mile from Hollow Rock. It is on the land of Mr. Jim Cleaver, of Hollow Rock.

The clay outcrops at the foot of a low hill for about 50 feet. It has been dug back for 30 or 40 feet, only a few cars having been shipped from here.

The following is a detailed section of the pit:

*Section of Cleaver pit, near Hollow Rock.*

|                                                                          | Feet |
|--------------------------------------------------------------------------|------|
| Hard red case-hardened sandstone, with small gravel scattered through it |      |
| 1 inch in diameter and clay pellets .....                                | 5    |
| Light greyish yellow, with red iron streaks, and very sandy .....        | 5    |

The bed of clay, which is 5 feet thick, is very impure, and is only mined when the other pits are in an unworkable condition. Roots and stones are scattered through it, and in places streaks of iron are visible. No analysis has been made of this clay.

The clay is at the base of a low hill, with easy drainage. The overburden is from 5 to 8 feet thick, but hard, covered with second growth timber. Surface indications show about three acres of clay.

The clay is hauled by wagon to Hollow Rock for shipment. Only one car was shipped in 1909, that being sent to the Harley Pottery Company, at Nashville, Tenn. This pit was opened up several years ago and worked intermittently since then, when the other pits were filled with water.

*H. M. Cooper pit*—This pit is very small, but has a better grade than the preceding pit. It is on the road two miles south of Hollow Rock, though not as high grade as the Teachout clay, on the land of Mr. H. M. Cooper, of Hollow Rock. Several carloads have been shipped to Nashville.

The clay is in the Ripley formation, and has a slight overburden of Lafayette. It is mined by picks, and hauled by wagon to Hollow Rock. Not working at present.

*Sands at Hollow Rock*—Mr. A. Nunnally, of Hollow Rock, ships molding sand, as well as sand for concrete and mortar purposes. This sand lies about 200 yards west of town on the north side of the Nashville, Chattanooga & St. Louis Railway. It is overlaid by about 2 feet of soil. The sand is of a brownish yellow color, but on drying becomes very much whiter.

*Huntingdon—elevation 414*—Several "blossoms" of good fire clay were found around Huntingdon, though none has been mined.

Six miles south of town on the Jenkins place the following exposure was found in a gulley:

*Section 6 miles south of Huntingdon.*

|                                                                                                                                              | Feet | Inches |
|----------------------------------------------------------------------------------------------------------------------------------------------|------|--------|
| Lafayette:                                                                                                                                   |      |        |
| Orange sand, loose and incoherent with very little gravel, several streaks of broken ironstone hard pans are scattered through the bed ..... | 12   |        |
| Iron sand hard pan .....                                                                                                                     |      | 6-12   |
| LaGrange:                                                                                                                                    |      |        |
| Sand, cross-bedded, case-hardened, micaceous of orange color, banded in light and dark layers .....                                          | 8    |        |
| Clay, white sandy, which is hard and does not slack easily, but forms icicles of clay, where water has run over it ..                        | 5    |        |

This deposit has too much overburden, and is too inaccessible to be of present use.

The following is a road cross section of the surface sands and gravels taken from the Purdy road 1 mile south of Huntingdon:

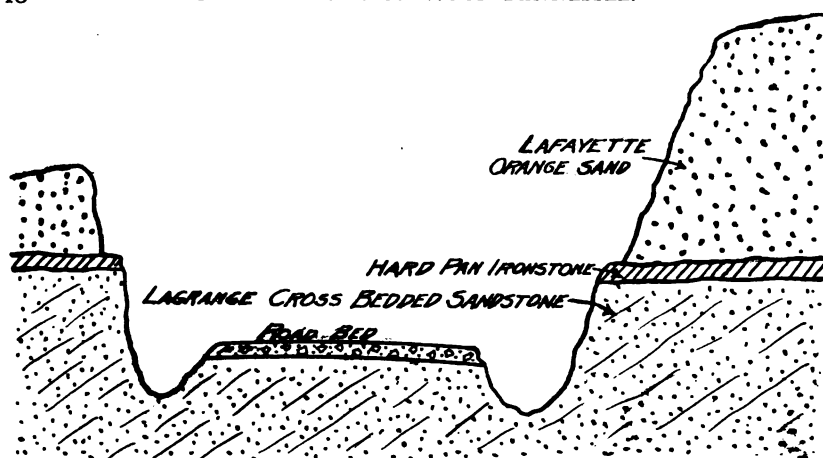


FIG. 4 CROSS SECTION OF ROAD SHOWING SURFACE FORMATION  
SOUTH OF HUNTINGDON

The Purdy road, after it turns south, has outcrops of Porter's Creek clays in the road cuts for  $2\frac{1}{2}$  miles. These are overlaid by Lafayette sands or clays, in many places only a foot or so thick.

About 3 miles from Huntingdon, on the same road, there is a deep road exposure, which does not show the Porter's Creek formation. The following is a section taken there:

*Section 3 miles from Huntingdon.*

|                                                                     | Feet |
|---------------------------------------------------------------------|------|
| Light orange sandy clay, no gravel hardened toward the bottom ..... | 12   |
| White sandy clay .....                                              | 1    |
| Hard sandstones cross-bedded to base of gully .....                 | 5    |

Still following the road, we get for the next 3 miles the Lafayette sands, on the surface, with an iron hard pan at their base, and then a band of hard cross-bedded sandstone. In some places in this lower bed is found a white sandy clay interbedded with sand streaks. Lower down this grades into a yellow and white banded sand, which finally changes into a sandy clay. This is generally the mode of occurrence of the beds in this region.

At Huntingdon the following log of the deep well as given from memory by Mr. Dill, the engineer in charge of the waterworks. Well is 213 feet deep:

|                                                                                 | Record of well at Huntingdon. | Feet  |
|---------------------------------------------------------------------------------|-------------------------------|-------|
| Lafayette:                                                                      |                               |       |
| Yellow sand .....                                                               |                               | 15    |
| LaGrange:                                                                       |                               |       |
| Hard red sandstone .....                                                        |                               | 10    |
| Porter's Creek:                                                                 |                               |       |
| Hard dark grey clay .....                                                       |                               | 45-55 |
| Very fine sand with mica .....                                                  |                               | 25    |
| Layers of grey clay and fine sand, each layer not more than $1\frac{1}{2}$ inch |                               | 60-75 |
| Ripley:                                                                         |                               |       |
| Lignitic material .....                                                         |                               | 6     |
| Dark red loose sand .....                                                       |                               | 25    |

On the road leading west of Huntingdon, about 3 miles out, in a deep gully, an orange sand is found, which is streaked with bands of white sandy clay. The sand is cross-bedded. Thickness of whole exposure is 40 feet, but the clay bands are so small that the clay can not be used commercially.

About 4 miles out, the following section was taken:

*Section 4 miles from Huntingdon.*

|                                                                        | Feet |
|------------------------------------------------------------------------|------|
| Light orange sandy clay with a small amount of gravel at the base, top |      |
| 4 feet cemented into small iron pellets .....                          | 12   |
| White sandy clay, with pink streaks .....                              | 3    |
| Ironstone hard pan .....                                               | 3½   |
| Dark orange cross-bedded sands streaks of light and then dark .....    | 15   |

The unconformity between the Lafayette and LaGrange formations seems to be at the top of the clay.

Two miles out on the road west of Huntingdon is an exposure of a white sandy clay, which is dark brown in one place. Indications are that this clay will get better under the hill, and a fairly good potters clay might be obtained. The clay is overlaid by 12 feet of red sandy clay, free from gravel.

At present no clay industry of any kind is located at Huntingdon. No clay outcrops of much value were seen, but from the formations here present, prospecting west of town might result in good ball clay being discovered.

*McKenzie*—There is located on the northern edge of the town a pottery operated by Mr. C. Sparks. (See Plate 7.) The clay is ground in a pug mill, worked by horse power; two-thirds of the mixture coming from the pit, and one-third being a sandy clay gotten nearby. The pit is located 6 miles north of McKenzie in Henry County. (For description, see page 97-A.) In winter the pottery is dried three days in the drying room, while in summer it is placed out doors to dry. The drying room has in it two long furnaces, 2 feet high and running nearly the length of the room. The jars are placed on top of these flues running back from the furnaces and on racks placed around the room. After drying, the ware is glazed by dipping in Albany slip, or for a white glaze a mixture of spar, whiting and ground flint. Zinc, too, is used with good results. Shrinkage of the clay is very slight, being 1 inch for every foot. The amount of clay used in a ten-gallon jug is 40 pounds, but after burning it has a weight of twenty-eight to thirty pounds. The finished ware is stored out in the yard without any cover.

The following products are made: Flower pots, 4 to 12 inches in diameter; chicken founts, one and two gallons; jars, one to ten gallons, and churns, one to ten gallons. About 1,000 fire bricks are made yearly for local use.

Two potters wheels run by foot power are used in molding the ware. They have no plaster of paris casts. The clay is tempered by cutting again and again against a fine wire stretched tight over a board. In this manner it is well mixed.

The burning is accomplished in one down draft kiln of 25,000 gallons capacity. Its diameter is 12 feet, with a height to the beginning of the crown of 6 feet. There are four fire grates. Coal from the Reniecke Coal Mining Company at Madisonville, Ky., is used in burning the ware. The actual burning takes about seventy hours; taking into account the setting and cooling, only two burns are made a month.

The pottery is shipped as far east as Dickson and north to Hickman, while south they are shipped to within 25 miles of Memphis. The rates are fairly good, but those on the Louisville & Nashville Railroad are slightly higher than on the Nashville, Chattanooga & St. Louis Railway.

*Costen, Moore & Co.*—The brickyard and its pit is located on the north side of the Nashville, Chattanooga & St. Louis Railway, about a fourth of a mile east of the depot. The property is owned by Costen, Moore & Co., of McKenzie. (See plate 6, Fig. B.)

The clay is mined from a pit just across the road from the brickyard. The surface clays are used down to 8 feet, the upper foot or two being Columbia loess, the rest Lafayette clay—of a light orange color. The clay has been mined over about two or three acres down from 3 to 8 feet.

The deposit is of a light orange sandy clay, very loose, and soft. No boulders or beds of gravel are found mixed with the clay, but after a depth of 8 feet has been reached the clay becomes too tough to be used in brick manufacture. This toughness seems to be due to the amount of iron present in the lower layer, while in the upper deposits it is lacking, as the iron has been leached out by the action of the percolating waters. The clay has enough plasticity to permit of being molded when wet if under pressure. The clay is mixed with a great deal of sand, and the grains can be readily seen.

Nothing has to be removed in mining this clay, as it is used from the surface down. The supply of this clay is inexhaustible, as the whole region is covered with it. Water is gotten from bored wells.

A company has been in operation at this place for twenty-one years. The clay is mined by picks, shovels, and horse scrapers, and is carried over to the mixer, a pug mill, Monarch make, which is run by steam. The bricks are made by the soft mud process, the molders being sanded instead of oiled. The bricks are dried on racks in the open air, the racks each having a little roof over them to keep off the

rain. They have here a shed capacity of nearly 200,000. The bricks are dried from four days to a week, according to the weather conditions. After drying the bricks are carried by wheelbarrows into the kilns and there set. No work is done in the winter months, as the bricks are apt to freeze and become ruined. No shrinkage tests have been made of the bricks either in drying or burning, as it is very slight.

Only soft mud bricks are made, though at one time a repress brick was made, but this was stopped as they cracked and scaled.

There are four updraft kilns of 170,000 capacity each. Coal is used in burning, and about eight days are taken for drying and burning. The kilns have eleven fire holes or "eyes" on the two long sides.

The capacity for the last year was 2,000,000 brick, the daily capacity being 20,000. The plant capacity is to be enlarged this winter. The rates on both railroads are fairly good, and bricks are shipped into a territory of about 50 to 75 miles radius.

The Louisville & Nashville Railroad has just put down a well 647 feet deep at McKenzie. The following is the section as gotten from M. P. Walden, Superintendent of Water Supply of the Louisville & Nashville Railroad:

*Section of well at McKenzie*

|                                        | Feet |
|----------------------------------------|------|
| Soil, loam and clay .....              | 10   |
| Sand, red .....                        | 26   |
| Sand, white .....                      | 11   |
| Sand, red (water struck) .....         | 20   |
| Sand, fine white .....                 | 34   |
| Sand, white, and pipe clay mixed ..... | 50   |
| Pipe clay, grey .....                  | 74   |
| Pipe clay, dark .....                  | 38   |
| Sand, yellow .....                     | 10   |
| Sand, white .....                      | 38   |
| Sand, white, coarser .....             | 9    |
| Pipe clay .....                        | 8    |
| Sand, fine, white .....                | 2    |
| Pipe clay .....                        | 2    |
| Sand, fine, white .....                | 16   |
| Pipe clay, grey .....                  | 122  |
| Pipe clay, dark .....                  | 47   |
| Sand, fine white .....                 | 6    |
| Pipe clay, dark or soapstone .....     | 20   |
| Sand, white, fine .....                | 35   |
| Sand, white, coarse .....              | 52   |

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647

A good water supply was here struck.

*Fire clay pit*—There is a small pit located two miles southwest of McKenzie, on Andy Pate's (col.) farm, which has been worked by Costen, Moore & Co. and C. Sparks, for fire brick clay to make the bricks for their kilns.

This clay is located on the side of a low hill, and is covered by an overburden of several feet of light orange sandy clay. The clay used for fire brick is a sandy white clay, streaked with iron stains, and in places nodules and gravel are scattered through the bed. The clay from indications covers three or four acres, and in no place should it have an overburden of more than 5 feet. The drainage is good. About one or two carloads of clay have been mined. None has been shipped out of McKenzie; it has all been used locally. The clay is too poor to be shipped, as much better fire clays are found elsewhere and directly on the railroad.

*Trezevant brickyards*—Brick are manufactured here by Mr. O. C. Sloan, of Trezevant. This yard is on the northeast edge of town, about 100 yards from the railroad.

The clay used here is taken from the surface. It is a light orange or red sandy clay of the Lafayette formation. It is used down to about 4 feet, below that depth it is too rough for brick making. The clay is mined from the side of the brickyard. An Eagle soft mud brick machine is used, which is run by a Huber engine of about ten-horse power. It has a capacity of 18,000 bricks daily. The bricks are dried in open air racks. Bricks are all of soft mud type and are burned in two updraft kilns (Dutch kilns) of 175,000 capacity each. Cord wood fuel is used, and about eight days are required for drying and burning.

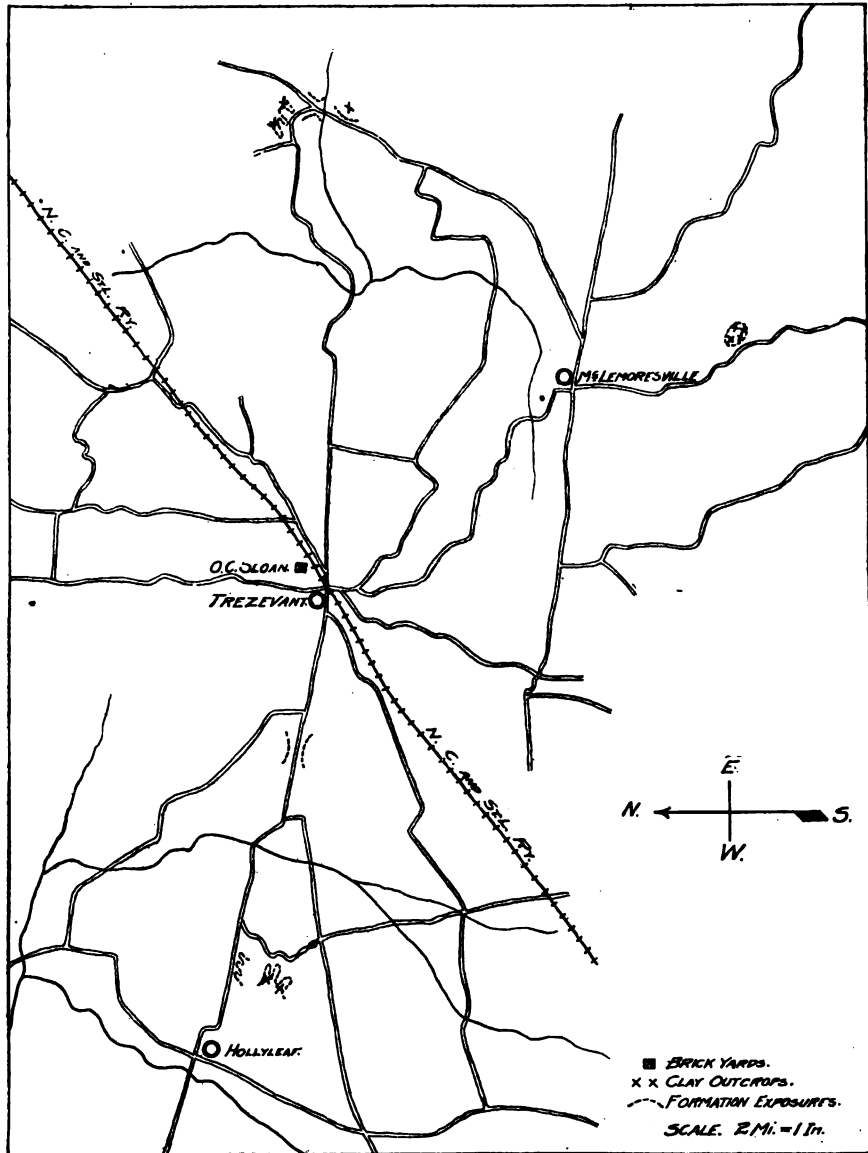
No bricks have been made since 1909, when 900,000 bricks were made. No bricks were shipped away, they all being used locally in brick buildings.

*On the Trezevant-Hollowleaf road*—Four miles out from Trezevant, on the south side of the road, are some gullies, which contain the following section:

*Section 4 miles from Trezevant.*

|                                  | Feet | Inches |
|----------------------------------|------|--------|
| Yellow streaked sandy clay ..... | 5    |        |
| Iron pan .....                   |      | 1      |
| White sandy clay .....           | 10   |        |

A sample of this lower bed of clay was tested, and burnt to a light cream color at the temperature of cone 11, with an air shrinkage of 6 per cent, and fire shrinkage 8.5 per cent. Its appearance suggests its use for fire brick. It is not plastic enough for a ball clay, even if the sand could be washed out.



MAP OF CLAY OUTCROPS AT TREZEVANT AND VICINITY, CARROLL COUNTY.

Just south of the preceding, a very plastic, light pink clay, free from grit is exposed in a number of gullies to the west of the road to William Watkins' place. In the gully farthest south just before the road goes down the hill, the following section was viewed:

*Section near Trezevant.*

|                                                                     | Feet |
|---------------------------------------------------------------------|------|
| Lafayette:                                                          |      |
| Light orange sandy clay, no gravel .....                            | 6    |
| LaGrange:                                                           |      |
| Darker orange case-hardened, cross-bedded sand, very little clay .. | 5-7  |
| A very good white clay, exposed to bottom gully .....               | 12   |

In another gully 100 yards north of the former and back from the road, another good exposure was found, as follows:

*Section west of Trezevant.*

|                                                                                                     | Feet |
|-----------------------------------------------------------------------------------------------------|------|
| Lafayette:                                                                                          |      |
| Clay, light orange sandy .....                                                                      | 5    |
| LaGrange:                                                                                           |      |
| Sand clay, cross-bedded, dark orange, case-hardened whitish clay pellets scattered through it ..... | 12   |
| Clay, white, exposed to bottom of gully .....                                                       | 3    |

The lower bed of white clay, of which only the top is exposed, is one of the best plastic clays, which was found outside of Henry County. This clay undoubtedly extends down at least 4 or 5 feet below the bottom of the gully, and should change into a better quality. In places a slight pink mottling is visible, but there is not an injurious amount of iron present. The clay has a fine conchoidal fracture. There is no grit or sand present, and no concretions or nodules of any kind were found.

This clay lens lies in the middle part of the LaGrange formation. The unconformity between that bed and the Lafayette lies between the soft light orange sandy clay, and the hard cross-bedded dark orange sand, which overlay the clay. The clay appears to extend northward from the exposure, and probably covers only 3 or 4 acres.

Outcrops can be found in most of the gullies around this locality on all sides of the hills, which will aid materially in determining the extent of the clay lenses. Any pit here could be easily drained.

The overburden, which will vary from 17 feet at the outcrop to about 25 feet under the hill, is at the top a loose sandy clay, easily removed. Below this is a bed of sand, case-hardened, which could be removed without much difficulty. This outcrop is 4 miles by road to Trezevant and  $2\frac{3}{4}$  miles by nearest road to the railroad, 4 miles south of Trezevant.

No clay has been dug at this point, and no other good exposures were seen, but prospecting done in this locality would undoubtedly uncover some good ball clay deposits. On the Hollowleaf-Trezevant road  $1\frac{1}{2}$

miles from Trezevant, a road exposure of a light yellow, sandy clay was found on a steep hillside. This clay is nearly white; and probably would become free from grit if the lens should be worked back.

*Newbill Crossroads*—On Mr. Ed Parnell's farm,  $4\frac{1}{2}$  miles out, are several gullies, on the northeast side of the road. The following is a section of them:

*Section at Newbill Crossroads.*

|                                                           | Feet |
|-----------------------------------------------------------|------|
| Clay, mottled light yellow or white, sandy .....          | 15   |
| Clay, banded layer of light orange and white, sandy ..... | 12   |

No good clay was found in this gully. In a second gully 50 yards from the first, this section was seen:

*Section at Newbill Crossroads.*

|                                                                                                      | Feet          |
|------------------------------------------------------------------------------------------------------|---------------|
| Clay, light orange, sandy, case-hardened in places and white clay pellets scattered through it ..... | 15            |
| Clay, yellow, no sand, exposed at base of gully on left side coming up to its head .....             | $\frac{1}{2}$ |

This clay is very plastic and free from grit. It has too much iron in it to be used for ball clay, but should make a good sagger clay. No determination was made of the depth of this bed. The hill that has the gully in it is of ten or twelve acres in extent, but in its highest part has an oberburden of 35 or 40 feet, which is prohibitive. Taken all in all this deposit could not be worked economically.

About one mile beyond this an exposure of the surface formations is seen, where the road goes down Baxter Hill. The following is a sketch of it:

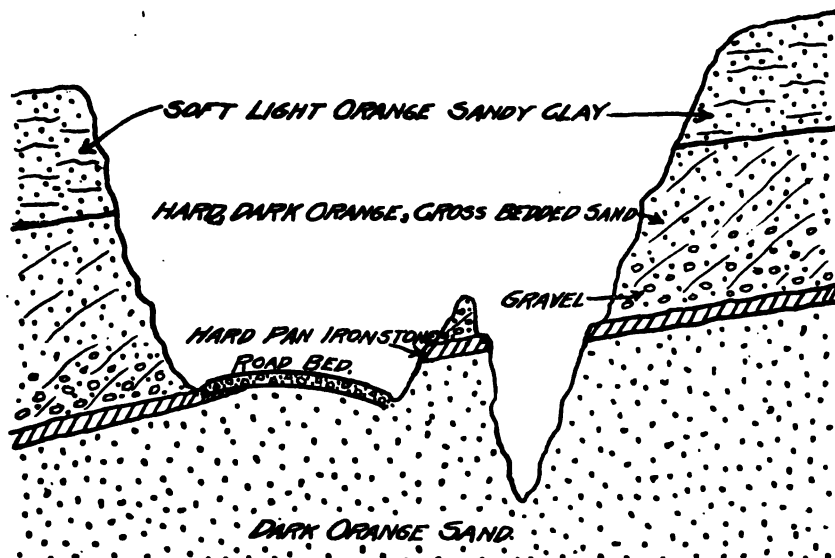


FIG. 5. CROSS SECTION OF ROAD SHOWING SURFACE FORMATION ON BAXTER HILL, 5 MILES EAST OF TREZEVENT.

One hundred yards further down the hill a small white sandy clay streak appears on the road cut. It is of no value.

On the road leading south of McLemoresville, 2 miles out, there has been about an acre washed away, leaving exposed the following section:

*Section south of McLemoresville.*

| Section on the west side:                                                                                             | Feet |
|-----------------------------------------------------------------------------------------------------------------------|------|
| Clay, light orange sandy .....                                                                                        | 4    |
| Sand, dark orange, with clay pellets, case-hardened, and cross-bedded<br>with soft iron concretions at the base ..... | 4    |
| Clay, white sandy .....                                                                                               | 10   |

This clay might make a fire brick, judging from its appearance, but it is about 6 miles from the nearest shipping point at Trezevant on the Louisville & Nashville Railroad.

On the road from McLemoresville to Trezevant,  $1\frac{1}{2}$  miles from Trezevant, on Capt. Bohannon's place, which is on the north side of the road, a dark grey molding sand is gotten at the base of the hill. This is covered by about 25 feet of overburden in the center of the hill, but none on the side where they are now mining it. This sand is made use of in the foundry at Trezevant by Hurdle Brothers.

### CHESTER COUNTY.

*Topography*—This county is very irregular in shape, and is situated in the southeastern part of West Tennessee. Its area is 300 square miles, most of which is drained into the Mississippi River. The Mississippi-Tennessee Divide runs through this county, and has a height of 600 feet in places. Along this divide the surface is very hilly and rough. Both the slopes are cut up, on the west by the headquarters of the Forked Deer, and on the east by small streams tributary to the Tennessee River. The middle and western part of the county are more level, the stream valleys being about 30 feet lower than the surrounding country, which is fairly level. The average elevation is 450 to 500 feet.

*Railroads and towns*—The Mobile & Ohio runs north and south through the center of the county, passing through Henderson, the county seat. This is the only town of any importance in the county.

*Geology*—The rocks consist of the Selma clay, and Ripley formation of the Cretaceous, the Porter's Creek and LaGrange of the Eocene and the Lafayette of the Pliocene. The east end of the county is underlaid by the Selma clay. In the central part of the county is the outcrop of the Ripley sands and clays, Henderson being on its western edge. West of the Ripley formation the Porter's Creek extends across

the county in a band 4 or 5 miles wide. The overlying Lafayette has been removed from it in most places. In the extreme western part of the county the LaGrange sands outcrop over an area 3 or 4 miles wide, drained by the Hatchie River.

*Clay*—No white clay was heard of in this county. The only place visited was Henderson, and no information could be obtained there relative to any white clay in the neighborhood.

If any clay is to be found, it should be looked for east or south of Henderson in the Ripley formation, where clay lenses are sometimes found; or in the extreme western edge of the county, in the LaGrange sands and clays, which are here several miles from the Illinois Central Railroad.

#### CROCKETT COUNTY.

*Topography*—This county lies between the middle and south fork of Forked Deer River, having an area of 267 square miles. The divide between these 2 branches of the river runs in a northwest and southeast direction. The central portion of the county is a gently rolling to level upland, with an elevation of 400 to 425 feet. Near the eastern and northwestern parts of the county the land is hilly on account of the nearness to the large streams. Along these rivers the elevation is lowest, being about 300 feet.

*Railroads and towns*—The Louisville & Nashville Railroad crosses the southeastern edge. The county seat, Alamo, is off the railroad. A new road is being promoted, which is to run from Dyersburg to Jackson, passing through Alamo and several other towns. This road, if carried through, will open up the county greatly.

*Geology*—The LaGrange underlies the whole county and is covered by a mantle of Lafayette, but in the northwest end the covering is of Columbia loess and loam several feet thick.

*Clays*—In the southeastern part of the county along the Louisville & Nashville Railroad, there are deposits of light colored sandy clays, which might be utilized. Clays found elsewhere lack transportation facilities. Dr. L. C. Glenn, in his paper on the underground waters of West Tennessee and Kentucky, mentions lignitic clays being found in the northwestern part of the county. These clays when dried have in places enough lignitic material in them to permit of burning. A clay like this would be of no use economically to clay manufacturers. This territory was not visited.

#### DECATUR COUNTY.

*Topography*—This county lies just west of the Tennessee River, and is drained entirely by that river. The highest elevation is 600 feet on the ridges, while along the streams the altitude is about 400 feet.

*Railroads and towns*—A branch line of the Nashville, Chattanooga & St. Louis Railroad runs across the center of the county, from west to east, having its terminal at Perryville on the Tennessee River. Decaturville, the county seat, is 5 miles south of the railroad, and is reached by a pike running from Parsons on the railroad.

*Geology*—Over half of the county is covered by the old Paleozoic limestones, while the rest of the county on the west is covered with the Eutaw sands of Cretaceous age, which were laid down on the old Gulf embayment. The limestone here is of Silurian age and is covered by a blue clay formed from the disintegration of said rocks. In places the limestone is overlain by deposits of Camden chert of Devonian age.

*Clays*—Just north of Perryville on the river are several pits where the Camden chert was worked. The chert goes to a depth of 40 to 60 feet to the limestones. This Camden chert is really a variety of novaculite, and has been used with very fine results as road metal. At present no novaculite is mined, as all the most available pockets have been worked out, and now all the quarries are in the limestone. This is being mined and crushed by the Memphis Stone & Gravel Company, Mr. R. H. Carney, in charge.

Just east of Parsons on the Nashville, Chattanooga & St. Louis Railroad, the Memphis Stone & Gravel Company have several other pits located that are worked for gravel. These pits were not being operated when visited.

No clays are used in this county at present, but there are surface clays over the limestone, and also clays in the Eutaw sands, which could be utilized for making common brick. (See introduction, p. 9, for clays at Parsons.)

#### DYER COUNTY.

*Topography*—This county is situated in the northwestern part of this area. It is bounded on the west by the Mississippi River, and on the south by the Forked Deer River, and its south fork. It has an area of 500 square miles. The eastern part of the county is characterized by hilly uplands, while the western portion is the alluvial flood plain of the Mississippi, Obion and Forked Deer rivers. These bottoms are 225 to 250 feet above sea level, while the uplands have an elevation of about 375 feet.

*Railroads and towns*—The Illinois Central Railroad enters the county in the southwest and traverses it, going out in the northeast corner. The Chicago, Memphis & Gulf Railroad goes from Dyersburg, the county seat, to Tiptonville, on the Mississippi River. Dyersburg is the largest and most important town in the county.

*Geology*—The formations which are on and near the surface here are the LaGrange, the Lafayette, the Columbia loess and the Alluvium.

Of these deposits only the Lafayette and loess are used in brick making. The LaGrange is too deep in most places, being laid bare only in a few of the deepest ravines. In most places only the loess is used, and it is about 30 feet thick on the Illinois Central Railroad. On the eastern edge of the county it thins out to a few feet.

*Clays*—No clay is used in this county, except for making common brick and drain tile, the latter being made at the brick yards, as no separate plants are in existence.

*Dyersburg*—A brick plant is located here, which is owned and operated by Mr. J. M. Nichols of this place. The pit is located by the side of the plant, and clay has been used down to 10 feet at which depth it becomes too tough to be used. This clay is a loose, unconsolidated loess, which is easily dug by pick and shovel. No stripping is required, as it can be used from the surface down.

The quantity of material is unlimited, and in no place is any overburden to be removed. The dark to black loess, which is used in making the tiles, is found on the southwest edge of town. This deposit varies with the light loess, as a surface deposit, and is in nearly as great abundance.

The plant has been in operation for many years, but no brick has been made for two years. A soft or stiff mud brick can be manufactured. A Quaker soft mud machine, with a daily capacity of 20,000, is used; also a Brewer machine, which is used for making the stiff mud brick. This latter machine can also be used for making tile. Its daily capacity in brick is 20,000, or in 5-inch tile it is 4,000.

One downdraft rectangular kiln of 300,000 capacity is used. The brick take two weeks to dry and burn. Wood is used in drying out, a half cord being allowed to the 1,000 bricks, while coal is used in the burning.

This plant has made few bricks since the Tennessee Brick & Tile Company opened up a plant here five years ago.

*Tennessee Brick & Tile Company*—This plant is located on the east side of the Illinois Central Railroad on the north edge of town. Mr. L. L. Lovin is manager.

The surface clays only are used at this plant. The clay to date has been dug to a depth of only 3 or 4 feet. The pit is located on the north side of the yard, and covers about one acre.

This plant has been in operation since 1905. The clay is dug by pick and carried by scrapers to the sheds, where it is stored for winter

use. The clay becomes better on storing, as weathering helps it. It is taken from the sheds and carried by wheelbarrow to the disintegrator, where it is ground up. From here a canvas tude carries the ground clay to the dry press machine. The machine is a AA-118, Anderson Brick Press, made by the Scott Manufacturing Company, Keokuk, Iowa. It has a daily capacity of 20,000. The dry clay is pressed into the molds from above, at the same time the bottom of the mold comes up slightly, giving a better compression. The die has one or two air holes in it to permit the escape of any included air, which would cause blisters in the brick. The dies are steam heated.

The brick are wheeled directly from the dry press machine into the kiln where they are stacked for burning. No sheds are employed for drying the bricks. The kilns are downdraft of beehive construction and eight in number. Three of the kilns have a capacity of 7,200 each, the other five holding 60,000 each. Each kiln has four chimneys and eight fireholes. Wood is used to dry out the bricks and coal to burn them. The complete process takes twelve or fourteen days.

In 1910, 3,000,000 brick were made, all dark red, pressed brick. They sell at from \$8 for kiln run to \$15 a 1,000 for selected brick. With good railroad rates the bricks are shipped in a radius of about 50 miles.

No other brick are manufactured in this county, nor articles of any kind which utilize clay.

#### FAYETTE COUNTY.

*Topography*—This county is in the southwestern part of West Tennessee, and is bordered on the south by the State of Mississippi. It has an area of 618 square miles. The greater part is hilly and rolling. It all drains into the Mississippi River through its tributaries, the Hatchie, Loosahatchie and Wolf rivers. The surface is very hilly in the southeast part around LaGrange, which is 531 feet above sea level. This region is the highest part of the county. The lowest is about 250 feet in the northwest part.

*Railroads and towns*—Four railroads enter the county, the Nashville, Chattanooga & St. Louis, which traverses it from east to west in the central part; the Southern, which runs along the southern border; in the central part, the Southern, which runs along the southern border; the Louisville & Nashville, which crosses the northwest corner, and the Illinois Central, which crosses the southeast corner.

Somerville, on the Nashville, Chattanooga & St. Louis Railroad, in the center of the county, is the county seat, and principal town. Moscow and LaGrange, on the Southern Railroad, are of importance.

*Geology*—The LaGrange underlies all of the county, being exposed in deep gullies in many places, notably around the town of LaGrange, from which the deposit takes its name. (See page 15.) The surface is covered by 10 to 20 feet of Lafayette sands, and a few feet of Columbia sand or loam, the loess appearing only in the extreme northwest corner.

*Clay deposits*—Lenses of potters and fire (?) clay are found in the LaGrange formation in the southeastern part of the county. The potters clay is found along the Southern Railroad, west of Grand Junction, and fire (?) clay is found at LaGrange and east of Moscow on the same road. The only brick plant is located at Somerville and utilizes the Lafayette clay.

*LaGrange*—Clay was formerly shipped from here to Memphis by Mr. Jim Davenport, who lives a quarter of a mile west of town. The following is a section of the pit at his place.

| <i>Section at Davenport place, LaGrange.</i>                  |  | <b>Feet</b> | <b>Inches</b> |
|---------------------------------------------------------------|--|-------------|---------------|
| Columbia formation .....                                      |  | 1-4         |               |
| Lafayette:                                                    |  |             |               |
| A dark orange sandy clay case-hardened .....                  |  | 2-4         |               |
| LaGrange:                                                     |  |             |               |
| Clay, white plastic, with yellow streaks slightly sandy ..... |  | 6-8         |               |
| Clay, Ochre color, very plastic little grit present .....     |  | 4-6         |               |
| Hard pan .....                                                |  |             | ½             |
| Sand at bottom of gully.                                      |  |             |               |

This lower bed of clay was used by the old Memphis pottery, which has now gone out of existence. The clay has an overburden of about 15 feet at the face, with a maximum of 25 feet in the center of the hill. If the sandy white clay could be utilized for fire brick, or otherwise, it would be so much gain as it would have to be removed any way. The clay has been worked about 150 feet, but if persistent, would cover five or ten acres. This deposit is located at the head of a deep ravine, which drains the pit.

Mr. Davenport ships a great amount of sand to Chattanooga and Memphis from a gully south of town, on the P. R. Beasley land. The sand is dug from an open pit and brings from \$1.25 to \$1.75 a cubic yard.

Mr. McNanee ships sand from the bottom of a short gully next to P. R. Beasley's land. He uses a small engine to haul the sand up to the top of the gully. Most of this sand is shipped to Memphis, bringing \$1.25 to \$1.75 a cubic yard.

West of town a half mile is a large pit operated by Mr. Jeff Dale, which is reached by a narrow gauge road. This sand is shipped to

Chattanooga. The sand is brought up an inclined tramway in tram cars worked by a steam hoist, and dumped into railroad cars. This gully is over 100 feet deep, and has the following section:

| <i>Section of Dale sand pit, LaGrange.</i>                                                                                          |       | Feet  |
|-------------------------------------------------------------------------------------------------------------------------------------|-------|-------|
| Light yellow sandy clay .....                                                                                                       | 1     | 1     |
| Red sand, loose, with an iron hardpan at the base .....                                                                             | 8-10  | 8-10  |
| Old brown sandy soil layer .....                                                                                                    | 2-3   | 2-3   |
| Sands, loose, uncemented, light in color, with orange bands in places, and streaks of pink and purple, in places cross-bedded ..... | 60-90 | 60-90 |

About three-fourths of a mile west of Grand Junction on the north side of the Southern railroad are the clay pits of W. T. Follis. (See sketch No. 11.) The clay is used by Mr. Follis in his pottery at Grand Junction. It outcrops in the bottom of a nearby railroad cut, and also in several small gullies. It is mined in pits about 15 feet square, dug straight down, about 40 feet. Several pits have been worked out. As soon as this occurs another pit is started a few feet away. The following is the general section of the pits:

| <i>Section in Follis clay pits, Grand Junction.</i>                                                                  |       | Feet  |
|----------------------------------------------------------------------------------------------------------------------|-------|-------|
| Clay, dark orange red, at the base a gravel bed, composed of quartzite not more than 3 or 4 inches in diameter ..... | 3-12  | 3-12  |
| Clay, pink and bally at top and breaks into little lumps .....                                                       | 6-8   | 6-8   |
| Clay in bluish bands, with fine white sand partings .....                                                            | 20-30 | 20-30 |

The clay from these small pits is sandy, and colored by the presence of a small amount of iron, which gives the clay a yellow or light pink color. It has a rough texture, breaks into layers, and does not slack readily. No gravel is found in the clay, but it is gritty to the touch.

These clay lenses all occur in the lower part of the LaGrange formation, of Eocene age. They are elliptical and take a direction about twenty degrees east of north, and seem here to be about eight acres in extent.

*Conditions affecting development*--These pits are drained by bailing. They are not worked in the winter. The overburden in the pit worked is about 5 feet; further back on the hill it increases to about 10 or 15 feet. It is soft and loose and can easily be removed by pick and shovel. The clay is lifted out of the pit by buckets or a windlass and hauled by wagon to the pottery at Grand Junction. This pit was formerly owned by Mr. J. H. Prewitt of Grand Junction, who shipped clay to New Orleans and other points. It has been worked for about eight years.

For a report of the pottery at Grand Junction, see page 77.

The Hancock pits are located on the Illinois Central Railroad, about 1 mile south of Grand Junction, principally on the east side of the

railroad, in Fayette County. The clay is overlaid by 4 to 6 feet of orange red sand, case-hardened, with a sprinkling of quartzite pebbles, up to one-half inch in diameter. The clay is a solid bed, very fine grained and sandy. It has a delicate pink color in places, but is mostly white on the outside, while on fresh exposure it is a light grey. Many beautiful leaf impressions were found in this clay, which had a beautiful pink tinge from the iron present.

This clay has been tried at Grand Junction Pottery, with poor results, as it checks, and does not hold the glaze. It has not been mined for several years.

*Moscow*—On Mr. Ike Chase's land, 2 miles from town, the following exposure was found in one of the numerous gullies:

*Section on Chase land, Moscow.*

|                                                                                                                         |             |
|-------------------------------------------------------------------------------------------------------------------------|-------------|
| Columbia formation .....                                                                                                | Feet<br>3-8 |
| Lafayette:                                                                                                              |             |
| A case-hardened sandy clay, dark orange with small gravel and clay pellets scattered through it .....                   | 6-10        |
| Unconformity—                                                                                                           |             |
| LaGrange:                                                                                                               | Feet        |
| At top a band of clay pellets, further down are clay streaks, with a sandy clay lens at the base to ravine bottom ..... | 6           |

Further on, where the Southern Railroad runs through Mr. Chase's land, 2 miles east of town, by railroad, another section was taken in the railroad cut, which is as follows:

*Section in railroad cut 2 miles east of Moscow.*

|                                                                                                                                                                                                    |       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Columbia formation .....                                                                                                                                                                           | 2-6   |
| Lafayette:                                                                                                                                                                                         |       |
| Light orange sandy clay, soft and loose, no gravel .....                                                                                                                                           | 0-3   |
| LaGrange:                                                                                                                                                                                          |       |
| In the center of the cut is the clay lens coming up in contact with overlying Columbia sands, while on the sides the clay lens is covered by several feet of LaGrange sands, dark orange in color. |       |
| Total thickness of LaGrange to railroad track .....                                                                                                                                                | 10-15 |

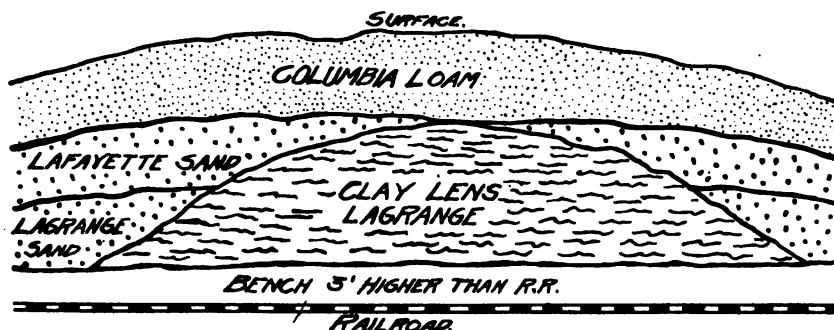


FIG. 6. EXPOSURE SHOWING CLAY LENS IN SOUTHERN RAILROAD 2 MILES EAST OF MOSCOW, TENN.

A well marked unconformity seems to exist here between the Columbia, Lafayette and LaGrange.

This clay is exposed on both sides of the cut, and is best seen on the south side. The hill extends about thirty degrees east of north. The area covered is about ten or twelve acres, and appears to be underlaid entirely by clay, as springs are found on the far edge from the railroad cut. The clay is gritty, and has fine sand partings, which divides it into layers, just enough sand being present to cause the clay to split. At the top, and down to 3 feet above the base of the cut, the clay is colored in spots a light yellow or pink, but at the bottom the clay becomes a light grey. The clay may make a fire brick, with the amount of silica that is present, while if this is washed out, a good potters clay would be gotten. A few years ago several carloads were shipped to Memphis for testing.

At the cut the overburden is 6 feet of loose sandy clay, which will increase to perhaps 15 feet in the highest part of the hill.

On Mrs. R. R. Wheeler's land at Moscow, is a deposit of molding sand, which is used by the Livermore Foundry, at Memphis.

Only about 2 feet of overburden has to be removed.

*Somerville*—Mr. F. H. Lightfoot planned several years ago to make brick. Machinery was bought, but operations were never commenced.

On the road from Somerville to Whiteville, clay is said to outcrop in gullies all the way from 1½ miles to 6 miles out. This was not visited.

#### GIBSON COUNTY.

*Topography*—Gibson County is situated in the north central part of West Tennessee. It is irregular in shape, and has as part of its northern boundary the South Fork of the Obion River, and as part of its southern boundary the middle fork of the Forked Deer. It has an area of 625 square miles.

The surface is mostly level, and slopes to the west, though in the eastern part of the county the surface is hilly and broken. The valleys are large and have wide flood plains. In the southeast an altitude of 500 feet is reached, while in the southwest, where the Forked Deer River leaves the county, the elevation is about 280 feet. The average elevation is about 400 feet.

*Railways and towns*—Three railroads enter the county, the Illinois Central, Mobile & Ohio and Louisville & Nashville. The Illinois Central traverses the central part of the county from north to south, while the Mobile & Ohio crosses the eastern edge in the same direction. The

southeastern part of the county is crossed by the Louisville & Nashville Railroad.

The county seat is Trenton, situated on the Mobile & Ohio Railroad in the center of the county. Humboldt and Milan are junction points of the Louisville & Nashville and Illinois Central, and Louisville & Nashville and Mobile & Ohio railroads, respectively. They are very thriving towns. Other smaller towns situated in the northern part of the county, are Rutherford, Dyer and Bradford.

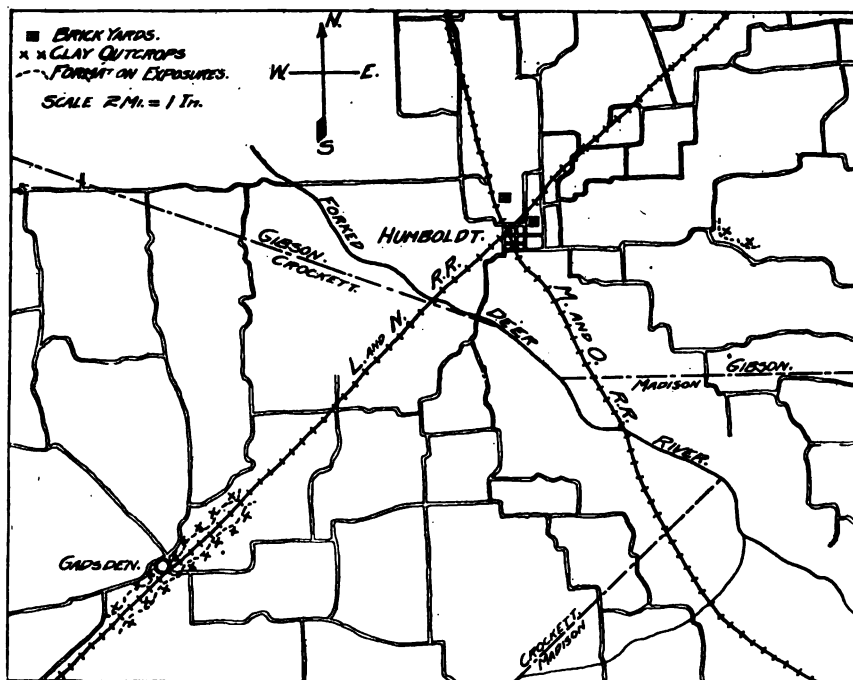


FIG. 7.

HUMBOLDT AND VICINITY. INCLUDING PARTS OF GIBSON, MADISON AND CROCKETT COUNTIES.

*Geology*—Three formations are exposed in this county, the LaGrange, Lafayette and Columbia loam and loess.

The LaGrange underlies the county, and is near enough to the surface in the eastern portion to be worked for clay, when it is present.

The Lafayette lies upon the LaGrange and forms the surface deposit in the eastern half of the county. It averages 20 feet, and is used for brick making in brickyards at Humboldt, Milan and Trenton.

The Columbia loam is only a foot or so thick, and is the soil layer. In the west this changes to the loess and becomes several feet thick.

*Clay deposits*—In the southeastern part of the county around Humboldt and Milan are several lenses of white sandy clay, located in the LaGrange formation. None of them are worked. As before mentioned, the Lafayette is used for brick making in the towns of Humboldt, Milan and Trenton.

*Humboldt*—A brick plant is located here, owned by McKnight Bros., of this place. Clay is taken from a pit, by the side of the plant, 2 to 8 feet deep, and over an acre in extent. The clay is of light red color, belonging to the Lafayette formation. It becomes very tough below the depth used.

This plant has been running since its establishment in 1902. The clay is brought by wheelbarrows to a chaser tempering wheel, which is run by a horse. After thorough working it is left to stand for twenty-four hours. The bricks are then hand molded, and placed in racks, which are under large sheds. The sheds have a capacity of 150,000, and the brick are air dried in them for about eight days. They have a repress machine through which they pass brick to make them smooth. There are three updraft kilns of 240,000 capacity, which use a burning system patented by John C. Boss. This is an underground air system. The air is forced up under the grates on which slack coal is used. A ten-horse power electric motor is used to run the blower, and all other machinery which is used. The brick are burned for eight days. The whole process of making a brick occupies six weeks.

Three kinds of brick are made: a common brick, a repressed brick, and an octagon brick for corners. One million bricks were made in 1910. They are shipped for a radius of 35 miles around Humboldt.

There is another brickyard located here, which was fitted up with steam driers and up-to-date machinery, but it has not been in operation for several years, and probably will not be operated again.

The following is a record of the deep well at Humboldt, which was stopped July 11, 1905, at a depth of 840 feet without striking water. Complete samples were taken of the different rocks and put in glass tubes and labeled. This would be a great help if it were done in all deep wells, as from such data the formations could be easily traced:

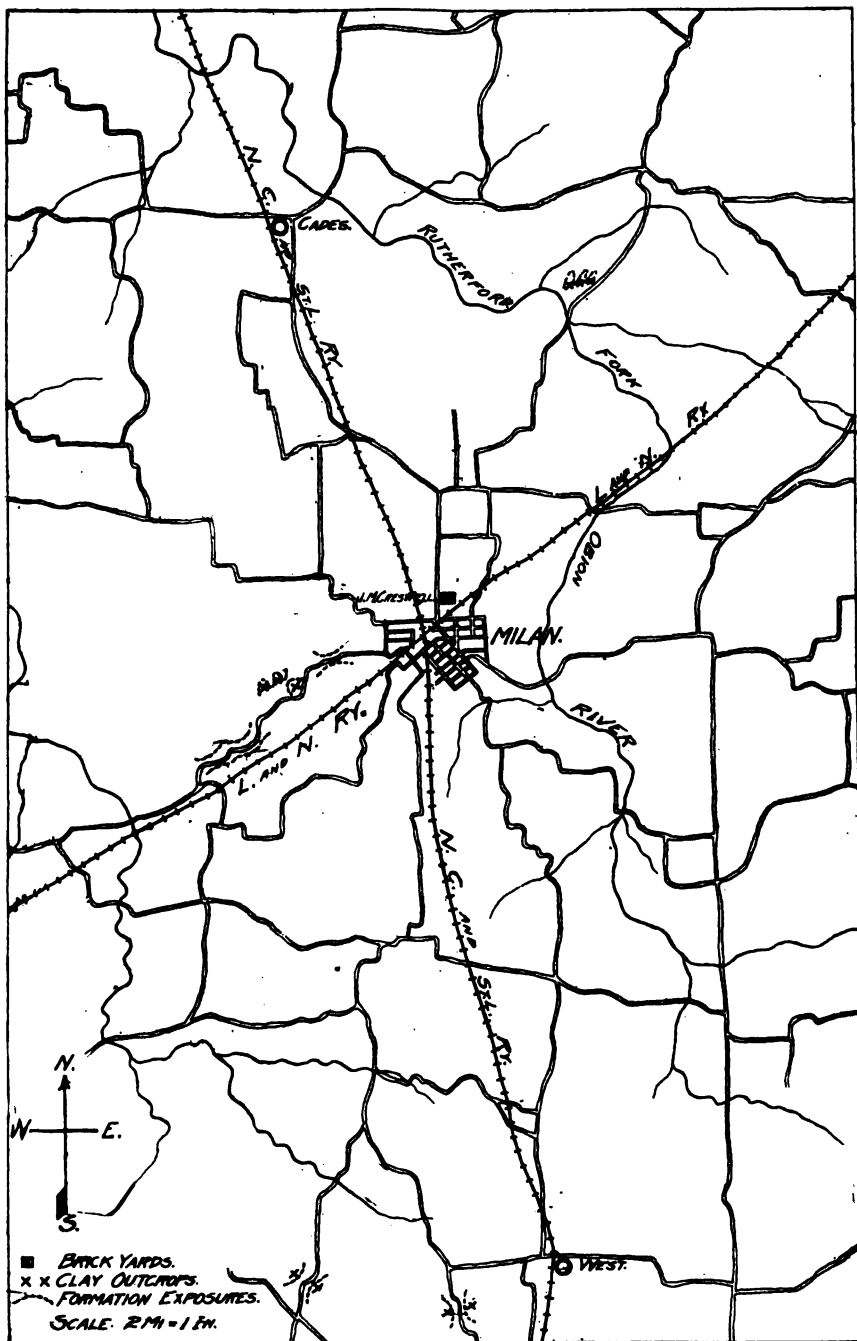
*Record of waterworks well, Humboldt.*

|                                                                                        | Thickness | Depth |
|----------------------------------------------------------------------------------------|-----------|-------|
| Light soil .....                                                                       | 5         | 5     |
| Sandy red clay hardened .....                                                          | 15        | 20    |
| Bands of fine white sand and pipe clay, about 4 feet greatest thickness of layer ..... | 173       | 193   |

|                                                                                                                                                                                                               | Thickness | Depth |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------|
| Coarse gravel up to $\frac{1}{8}$ of an inch in diameter composed of quartzite, novaculite, and iron cemented sand grains. A fragment of a five sided coral was found. $\frac{1}{8}$ inch cross section ..... | 214       | 417   |
| White sand, 1-16 of an inch is largest diameter, slightly stained with iron .....                                                                                                                             | 8         | 425   |
| Same, only finer .....                                                                                                                                                                                        | 10        | 435   |
| Same, finer .....                                                                                                                                                                                             | 3         | 438   |
| Sand varied in colors, novaculite, quartzite, pink quartz and iron grains, average size 3-32 inch .....                                                                                                       | 1         | 439   |
| Iron sand hard pan .....                                                                                                                                                                                      | 1         | 440   |
| Fine white sand, slightly stained with iron ..                                                                                                                                                                | 20        | 460   |
| Same, only a few mica flakes .....                                                                                                                                                                            | 10        | 470   |
| Very fine white sand, mostly quartzite, a few dark grains .....                                                                                                                                               | 30        | 500   |
| Iron stained sand 1-16 inch in diameter .....                                                                                                                                                                 | 6         | 506   |
| Same, only more iron, looks yellow .....                                                                                                                                                                      | 4         | 510   |
| Finer sand, less iron stain .....                                                                                                                                                                             | 3         | 513   |
| Iron sand hard pan .....                                                                                                                                                                                      | 1         | 514   |
| Record from 514 to 542 lost.                                                                                                                                                                                  |           |       |
| Hard sandy clay, yellowish, brown with black grains, sand particles very fine .....                                                                                                                           | 44        | 558   |
| Ironstone hard pan .....                                                                                                                                                                                      | 1         | 559   |
| Same, only harder .....                                                                                                                                                                                       | 4         | 563   |
| Ironstone hard pan .....                                                                                                                                                                                      | 1         | 564   |
| Very fine white sand, dirty looking .....                                                                                                                                                                     | 46        | 610   |
| Same, only lighter in color, very little iron stain .....                                                                                                                                                     | 5         | 615   |
| Same .....                                                                                                                                                                                                    | 10        | 625   |
| A brown black woody lignitic material, overlain by iron pan .....                                                                                                                                             | 23        | 648   |
| Porter's Creek formation—                                                                                                                                                                                     |           |       |
| An iron pan and then what looks like Porter's Creek clay (one fragment) .....                                                                                                                                 | 19        | 667   |
| Fine dark grey sand .....                                                                                                                                                                                     | 1         | 668   |
| Porter's Creek clay greyish brown, with many mica flakes .....                                                                                                                                                | 14        | 682   |
| Grey sand layers mixed with Porter's Creek clay .....                                                                                                                                                         | 18        | 700   |
| Brownish grey micaceous sand, semi-hardened .....                                                                                                                                                             | 4         | 704   |
| Same, lighter in color .....                                                                                                                                                                                  | 44        | 748   |
| Hard streaks of typical Porter's Creek clay and grey sand alternating .....                                                                                                                                   | 50        | 798   |
| Light grey micaceous sand, harder and less mica present .....                                                                                                                                                 | 12        | 810   |
| Light grey, hard, little mica present .....                                                                                                                                                                   | 13        | 823   |
| Very hard dark grey sand mica present, well stopped .....                                                                                                                                                     |           | 840   |
| Started with a 12-inch hole and stopped with a 4-inch one.                                                                                                                                                    |           |       |

From the samples of borings that were examined it would seem that the Porter's Creek commences at 648, and was still being bored into when the well stopped at 840 feet, making it have a thickness of 192 feet.

This would make the LaGrange formation 628 feet thick, overlain by 20 feet of the Lafayette. If these suppositions are correct, this



MAP OF CLAY OUTCROPS AT MILAN, GIBSON COUNTY, AND VICINITY.

would make the Porter's Creek have a greater thickness than heretofore recorded. At Jackson, in the deep well, only 175 feet of it were encountered, while here they have passed through 192 feet, and are still in the bed.

The following exposure was seen two miles east of Humboldt on the Jackson road:

| <i>Road exposure 2 miles east of Humboldt.</i>                                             |  | Feet | Inches |
|--------------------------------------------------------------------------------------------|--|------|--------|
| Clay, light orange sandy to gravel .....                                                   |  | 5    |        |
| Iron pan .....                                                                             |  |      | 2      |
| Clay, sandy white, not uniform, streaked with pink, near bottom<br>has sandy streaks ..... |  | 5    |        |

This is a fair potters clay, or a fire brick clay.

*Milan*—A brick plant, owned and operated by Mr. J. M. Creswell, is operated here. It is situated on the north edge of town about half a mile from the railroad. The clay is mined from the surface down to a depth of 6 feet. At present only 3 feet have been dug. This pit is located by the side of the brick plant and covers several acres. Red Lafayette clays are used.

The plant has been in operation since 1901, on its present site. The clay is dug with a pick and carried by scrapers to the vats, where it is soaked over night. The clay next morning is dumped on a conveyer belt, which runs to the soft mud machine, which has a capacity of 20,000 daily. Ten men are required to operate it. A ten-horse power Waterloo gasoline engine is used to run the machine and conveyer. From the brick machine the bricks, which are placed on pallets, are carried to the racks, where they are air-dried out doors for 4 days. The racks have a capacity of 60,000 brick.

There are four updraft (Dutch) kilns of 20,000 capacity each. They are 28 feet wide, 52 feet long and 11 feet high. There are twelve "eyes" on both long sides. Wood is used to burn with. Ten days are required to complete a kiln burn.

A common wet mud brick is made. They are shipped as far as Bradford and to Toone on the Illinois Central Railroad, while on the Louisville & Nashville Railroad they are shipped as far as Trezevant and Stanton.

A new well has been completed at the waterworks, 113 feet deep. The following log was given from memory by the engineer in charge:

| <i>Record of well at Milan.</i>                                     |  | Feet |
|---------------------------------------------------------------------|--|------|
| Sand, red .....                                                     |  | 40   |
| Clay, pipe, upper part white, while the lower was bluish grey ..... |  | 45   |
| Sand, coarse white .....                                            |  | 12   |
| Sand, fine white .....                                              |  | 8    |

On the lower road to Trenton,  $1\frac{1}{2}$  miles from Milan, the following exposure was found:

| <i>Section <math>1\frac{1}{2}</math> miles from Milan.</i>                            |                | Feet |
|---------------------------------------------------------------------------------------|----------------|------|
| Soil, light yellow sandy .....                                                        | 3              |      |
| Clay, soft dark orange sandy .....                                                    | 4              |      |
| Sandstone, cross-bedded, hardened, with clay pellets, no gravel .....                 | 13             |      |
| Streak light yellow sandy clay .....                                                  | $1\frac{1}{2}$ |      |
| Sandstone, cross-bedded, hard, not as dark orange as preceding, to foot of hill ..... | 12             |      |

In a gully 200 yards to the north of the road a good white sandy fire brick clay was found. In places the clay was light grey and contained leaf impressions scattered through it, though not in profusion, as in some other beds visited. It was covered by 2 feet of light orange sandy clay. On the highest point of the hill the overburden would not be more than 15 feet. A pit, if opened here, could easily be drained into a nearby gully.

On the second hill back of the lower road to Trenton,  $1\frac{1}{2}$  mile out, there are some other gullies showing good exposures of clay.

On top of the clay is 4 feet of light orange sandy clay not hardened. This will not increase to more than 12 feet in the deepest place. The clay extends down to the base of the gully a distance of 12 feet. The upper 2 feet is streaked with iron, and is less sandy than the remainder. The deposit is a very sandy, fine grained white clay.

These deposits are near enough to the town or the railroad to be shipped or worked. As the clay seems very free from all impurities but sand, washing might leave a good ball clay.

About 1 mile from town, on the lower Trenton road, the following sketch was made of the road sides:

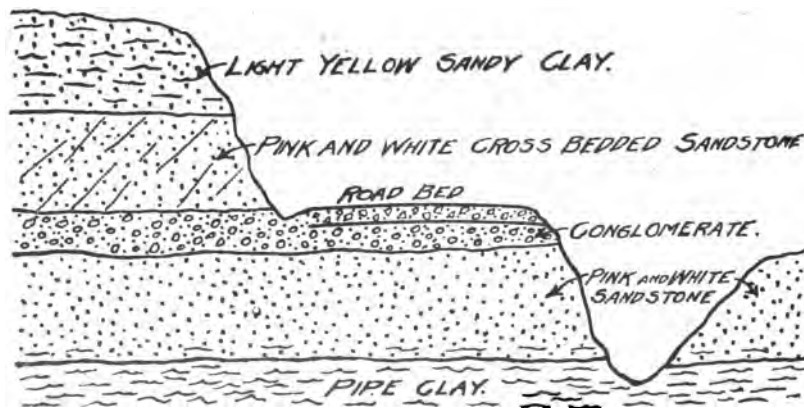


FIG. 8. CROSS SECTION OF ROAD SHOWING SURFACE FORMATIONS, 1 MILE WEST OF MILAN ON LOWER TRENTON ROAD

The bottom clay is an impure potters clay, with too much overburden to admit of working. No gravel is found anywhere except just under the road where there is a band about 1 foot thick cemented together, the intestices being filled with sand.

Three miles north of Milan, on the Trezevant road, about 150 yards to the west, the following exposure was found:

| <i>Section 3 miles north of Milan.</i>                                |    | Feet | Inches |
|-----------------------------------------------------------------------|----|------|--------|
| Sands, dark orange, lower 4 feet cross-bedded and case-hardened       | 10 |      |        |
| A band of white plastic clay with yellowish tinge                     | 4  | 3    |        |
| Iron hard pan                                                         |    | 1-2  |        |
| White sand hardened, has a pinkish tinge in places to bottom of gully | 15 |      |        |

This sand is the nearest approach to a glass sand found in West Tennessee. It might be washed and used for such a purpose. There is a large quantity of it, as it is exposed along the face of the hill for about 200 yards. It probably covers at least 25 or 30 acres.



FIG. 9.  
HARDEAN COUNTY, SHOWING GEOLOGICAL FORMATIONS.

On the northwest side of the Louisville & Nashville Railroad, two miles southwest of Milan, about 12 feet of white sandy clay are exposed to base of cut, overlaid by 5 feet of light orange sand. This clay is of the same kind as that found on the lower Trenton road.

*Trenton*—Bricks are manufactured here by J. W. Barrett. The plant is located a half mile south of corporation limits, where the clay is also procured. The plant was started twenty years ago. The surface Lafayette clays are used down to 3 feet. This clay is mixed with the surface soil for making the bricks, one-third soil and two-thirds clay being used. The clay is dug in the winter and permitted to weather, as this improves its plasticity. Brick are made only during the summer.

The clay is mixed or tempered by a chaser wheel, which runs in a circular pit 18 feet in diameter and 18 inches deep, with a wooden floor. There are three pits, and the wheel is moved from one to the other. The clay, after being mixed, is allowed to stand over night. It is then hand molded into bricks. The daily capacity is 5,500. The bricks are then placed on open air racks and dried for a week.

The kilns are of the scove type, and are built up each time. They are made to hold from 100,000 to 200,000 brick. They are forty brick high and 18 feet wide, with walls 13 inches at the base and 9 inches at the top. The "eyes" are made 17 inches from center to center. The bricks are dried and burned with wood, it taking four days to dry and seven days to burn them. (See plate 5, Fig. A.)

The only brick made are mud pressed, and most of them are sold locally. A few are shipped in a radius of 30 miles. Only 600,000 were made in 1910, which was below the general yearly run.

#### HARDEMAN COUNTY.

*Topography*—This county is situated in the south central part of West Tennessee, and is rectangular in shape, containing 655 square miles. It is bounded on the south by the State of Mississippi.

It is drained into the Mississippi, through the Hatchie, Loosahatchie and Wolf Rivers, the Hatchie draining almost the entire area as it runs through the county from the southeast to northwest. The county is very hilly in the southern and northeastern part, while the western and central portions are slightly rolling or level. The lowest point is 300 feet above tide, where the Hatchie leaves the county, and the highest is over 600 feet in the southwestern part, where portions of the old plateau are left.

*Railroads and towns*—The county is entered by three railroads, the Nashville, Chattanooga & St. Louis, which cuts off the northwest corner, Illinois Central crossing from northeast to southwest and Southern crossing the south edge.

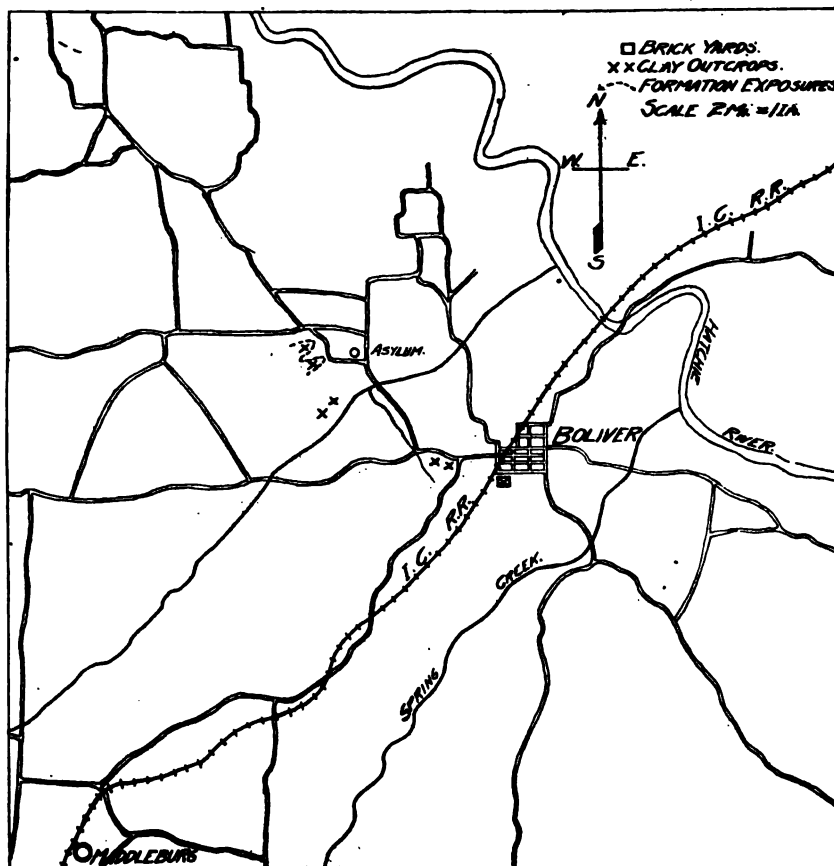


FIG. 10.

BOLIVAR, HARDEMAN COUNTY AND VICINITY.

The county seat and largest town is Bolivar, which is situated on the Hatchie River and Illinois Central Railroad. It is one of the oldest towns in this portion of the State, some of its first citizens having founded Memphis. At that time a line of steamboats ran on the Hatchie from Bolivar to Memphis. The river is not navigable now. Two miles west of Bolivar is located the West Tennessee Hospital for the Insane. The only other towns of importance are Grand Junction in the southwest, where the Illinois Central and Southern cross; Mid-

leton on the Southern in the southeast corner of the county. In the north, Whiteville on the Nashville, Chattanooga & St. Louis, and Toone on the Illinois Central, are the best towns.

*Geology*—Over one-half of the county is underlaid by LaGrange. East of this the Porter's Creek and Ripley outcrop in narrow bands. The whole county is covered by a thin blanket of Lafayette sands.

*Clay deposits*—No clays are worked in the Ripley or Porter's Creek formations in the county. Clay lenses in the LaGrange formation have been worked around Grand Junction, and Toone, while at Bolivar some unworked lenses were found. At several towns the Lafayette clays are worked for brick.

*Bolivar*—The Bolivar Brick & Tile Company is located here on the Illinois Central Railroad. The firm started operations in 1905. Surface clay is used down to 8 or 10 feet. This is red Lafayette clay. Below that depth it becomes too tough. The clay is hand mined, and carried by scrapers to the mixers. It is pulverized and run directly through a "Success" soft mud machine, having a daily capacity of from 20,000 to 25,000. The brick machine is run by a 50-horse power engine and 60-horse power boiler. The bricks are taken from the machine and laid directly on pallets, which fit in the drying racks. Here the clay is sun-dried for one week. The drying racks have a capacity of 200,000.

The kilns are of the Scove type. As a rule three or four of them are made with a capacity of from 250,000 to 350,000 each. Wood is used entirely in the drying and burning of the brick. It takes from eight to ten days to burn.

The brick are not repressed. The bricks are shipped about 60 miles north and south on the Illinois Central railroad.

*West of Bolivar at the asylum*—There were some old clay pits located in Buttermilk Creek on R. D. Cross' land, which is 1 mile southwest of the asylum. These pits were worked 15 or 20 years. They have been entirely filled in, and no outcrops could be found. As these pits are situated in the bottom of a creek, not well situated for working, they would require pumping machinery to drain. The clay was used for pottery, and was said to be of exceedingly good quality. There is probably 15 feet overburden, as the banks of the stream are 5 to 10 feet high, and the stream has filled in at least 5 feet.

A very good exposure of ball clay was found about half a mile west of the asylum on State land. A section of one of the gullies is as follows:

*Section on Asylum land near Bolivar.*

|                                                                                                   | Feet  |
|---------------------------------------------------------------------------------------------------|-------|
| Clay, light orange, sandy, soft at top, hardened at base, a few gravel scattered at the top ..... | 10-20 |
| Gravel layer of quartzite, up to one inch in diameter .....                                       | 1½    |
| Clay, light pink at top and white and sandy at bottom .....                                       | 6-8   |
| Sand, white, fine grained, streaked with clay to bottom of gully .....                            | 3-6   |

The hill lies about twenty degrees west of south and covers about 30 acres.

The clay is one of the best plastic found outside of Henry County. It is not sandy at the top and does not appear to have too much iron or other impurities in it to keep it from burning white. It has a conchoidal fracture and a smooth texture.

The overburden, which will not exceed 30 feet, is loose in most places and could be easily removed. Pits could be drained by the ravine to the east. They would be within one-quarter mile of the pike to Bolivar 2½ miles distant.

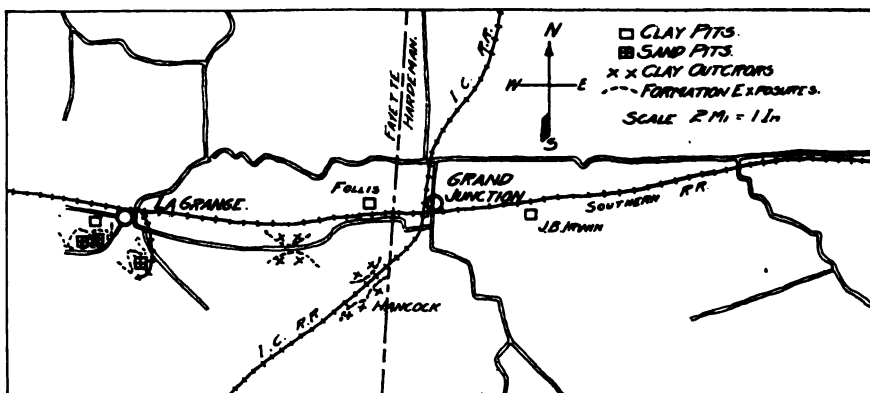


FIG. 11.

GRAND JUNCTION, HARDEMAN COUNTY, LAGRANGE, FAYETTE  
COUNTY AND SURROUNDING TERRITORY

A clay outcrops at the McNeal Spring on Mrs. Octavia Polk's land, about 1 mile from Bolivar, on the west side of the asylum road. This clay was used to make pipes.

All the wells bored in Bolivar have the following general section:

| <i>Section of wells bored in Bolivar.</i> |  | <i>Feet</i> |
|-------------------------------------------|--|-------------|
| Sand and red clay .....                   |  | 65          |
| Clay, solid, grey .....                   |  | 25          |
| Sand and clay mixed .....                 |  | 100         |

*Grand Junction*—The Grand Junction Pottery, owned and operated by W. T. Follis, has been in operation here since 1901. Clay is gotten from the plant pits in Fayette County. (See p. 62.) The clay is ground in a wet wan crusher, which has a capacity of about 1 ton an hour. From the crusher it is taken and hand-welded by throwing it against a tightly stretched wire. The two pieces are taken up and pressed together and thrown again. The ware is molded on potters wheels, worked by footpower. For the small ware plaster of paris molds are used. The ware is steam dried for 24 hours, then glazed in Albany slip, or Bristol white glaze.

One downdraft beehive kiln with a capacity of from 6,000 to 7,000 gallons is used. It has a diameter of 16 feet and a height of 8 feet to the curve. At the base the walls are 5 feet thick. Coal is used for drying and burning, which occupies from 12 to 24 hours.

The following articles are made: churns, 1 to 10 gallons; jars,  $\frac{1}{2}$  to 20 gallons. Both these articles are made in molds up to 3 gallons; jugs,  $\frac{1}{2}$  to 5 gallons ( $\frac{1}{2}$  to 2 gallons made in molds); flower pots, 5 to 12 inch, chambers 9 inch, chicken founts,  $\frac{1}{2}$  gallon; pitchers from 1 quart to 2 gallons are turned; also a few fire brick and sewer pipes are made for local use. The ware is mostly shipped south and west.

The Irwin clay pits are located  $1\frac{1}{4}$  miles east of Grand Junction on the south side of the Southern Railway. All the clay in sight has been mined. This was tried by Mr. Follis in his pottery without success. The most extensive deposits here are sand.

*Hickory Valley*—Only poor sandy clay of no value was seen here. It was 2 miles southeast of town on the north side of the road. The following is the section seen:

| <i>Section at Hickory Valley.</i>                                        |  | <i>Feet</i> |
|--------------------------------------------------------------------------|--|-------------|
| Soil .....                                                               |  | 1           |
| Clay, light orange, sandy, upper part in bands of white and orange sand. |  |             |
| Lower part hardened, and peppered with gravel .....                      |  | 8-10        |
| Clay, sandy, white, to case of gully .....                               |  | 4-6         |

Another exposure of poor, sandy clay is seen 2 miles further on, in a gully on Mr. Woods' land.

A clay bed is said to outcrop on a Mr. Fergerson's land, 6 miles west of Hickory Valley. This was not visited.

*Middleburg*—There are some gravel pits located here from which sand is sometimes shipped into Memphis.

*Middleton*—Mr. J. D. Sasser, Sr., operates a brick plant here intermittently. It is located  $\frac{1}{4}$  mile from the station on the west side of the branch road, which runs south to Mobile, Alabama. The plant has been idle for 2 years, but work is to be resumed this year. The clay used is the dark red Lafayette, the Columbia loam or sands being thrown aside. They have one stiff mud brick machine, with a capacity of 20,000 brick daily, operated by steam. The brick from this machine are placed in racks and dried for a week. There are four open air drying sheds, 15 by 150 feet. Scove kilns are used, taking twelve days to a burn and using  $\frac{1}{2}$  cord of wood for 1,000 brick.

The average yearly run is 200,000 brick, which are all used locally.

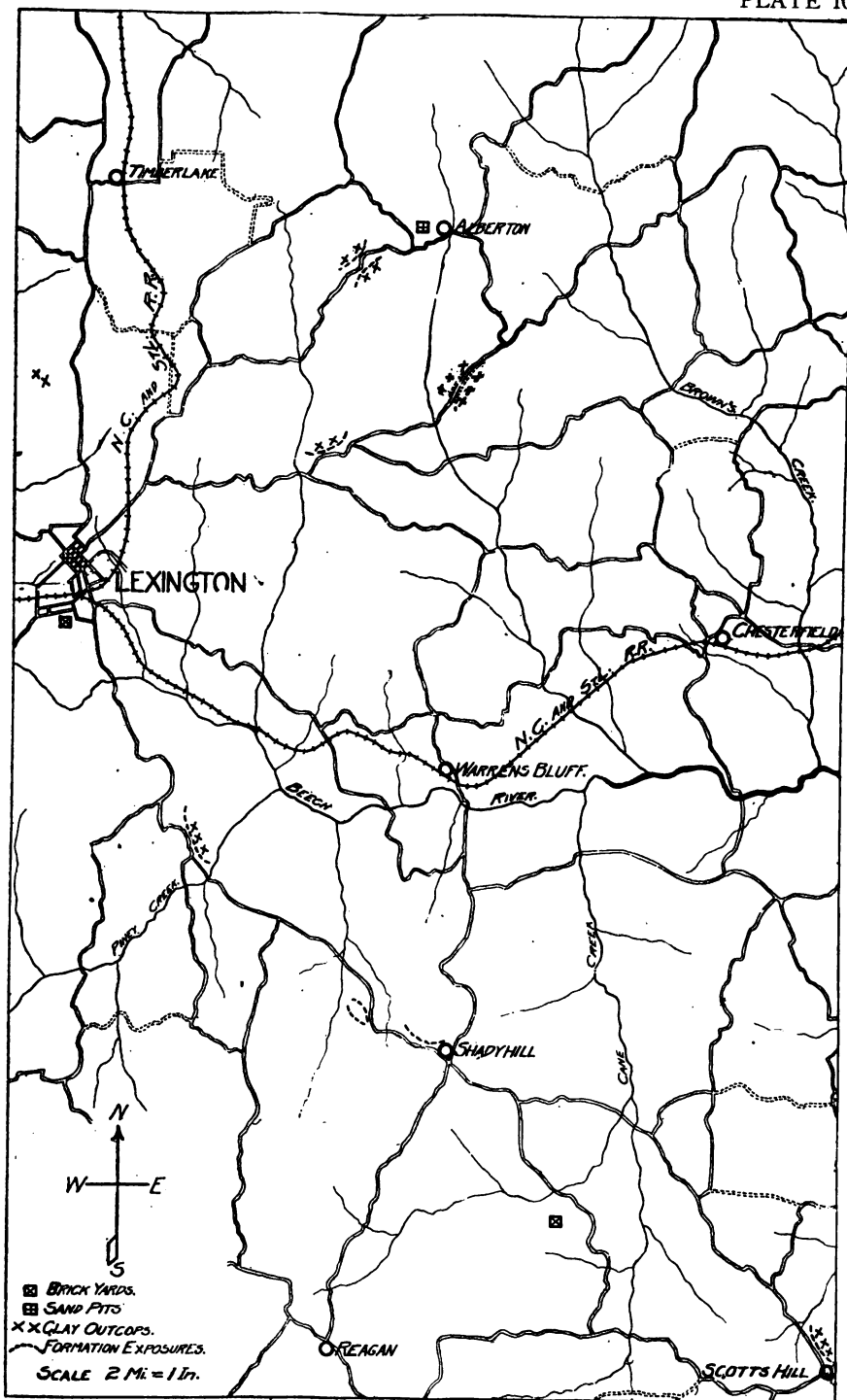
*Rogers Spring*—About 12 feet of fine, cream colored molding sand shows in a railroad cut on the Southern Railway,  $\frac{3}{4}$  mile west of the station. It is overlaid by about 3 or 4 feet of overburden. It adjoins land belonging to Mr. Ike Chase, of Moscow, Tennessee. Mr. Chase also reports 20 or 30 feet of dark grey clay, black when wet, on a hillside 100 yards north of the railroad, and 1 mile west of Rogers Spring. The clay is overlain by 10 feet and more of overburden. This clay must belong to the Porter's Creek formation.

*Saulsbury*—Sand is shipped from here to Memphis by the Durden Sand Company.

*Toone*—Mr. R. B. Keller owns and operates a pottery on the west edge of Toone about  $\frac{1}{2}$  mile from the railroad. The clay is mixed and ground in an old wooden upright horsepower pug mill, then hand wedged, turned on potters wheels, and after sun drying for two days is burned in a downdraft beehive kiln, with 3,000 gallon capacity. Albany slip clay is used. Wood is used for the drying,  $1\frac{1}{2}$  cords being required; while 3 tons of coal are used in the burning.

The following ware is made: Churns, 3 to 6 gallons, jars 1 to 10 gallons, pitchers,  $\frac{1}{2}$  to 1 gallon, chambers, chicken founts, cuspidors, milk pans, flower pots, 6, 8 and 10 inches, and jugs 1 and 2 gallons. Nothing is shipped by rail, all is sold in the surrounding country.

The plant uses clay from a pit 2 miles north of Toone on Mr. Joe Pipkin's land. There are 2 to 8 feet of dark orange-red sandy clay overlying the clay, which is white, with slight yellow coloration in



MAP OF CLAY OUTCROPS AT LEXINGTON, HENDERSON COUNTY AND VICINITY.

places. This bed is 5 feet thick. Further up the ravine in which the clay is mined, a dark grey clay appears, which burns very white. This clay is about 7 feet thick, and overlaid by 2 or 3 feet of white clay.

There is also a small bed of white clay about 3 feet thick at the pottery, but it is too tough to be used. It is overlaid by 5 to 15 feet of overburden of dark orange sand.

*Whiteville*—A brick plant was started here in 1910. It is owned by Mr. Robert Richards, and managed by Mr. A. M. Moore. The plant is on the northwest side of the Nashville, Chattanooga & St. Louis Railway and 200 yards southwest of town.

The clay is dug from a pit, located by the side of the machinery. The clay can be used down to 15 feet. The first 4 feet is Columbia loam, the remainder is Lafayette red sandy clay, with iron specks scattered through it.

The clay goes direct from the pit to a steel No. 3 stiff mud machine, where a little water is mixed with it. The clay is forced out of a die (which is steam heated), as a long ribbon, which is cut into bricks of the required length. The machine has a daily capacity of 20,000.

The bricks are air dried for 2 days in a shed of 100 feet square. A steam dryer is to be installed so that brick can be made all the year.

One updraft kiln of 150,000 capacity was in use when the plant was visited. Two others are to be built this year. The process of drying and burning in the kiln occupies ten days, using wood.

Only dry press brick is made. Last year with a late start 250,000 were manufactured. They are used locally.

#### HARDIN COUNTY.

*Topography*—This county lies in the southeast corner of West Tennessee. It is bounded on the south by Mississippi and Alabama. The county has an area of 587 square miles, of this only one-third is located west of the Tennessee River, and in West Tennessee. This part of the county is cut up greatly by the small streams which flow into the Tennessee River. Back from the streams the surface is fairly level. The highest part of the county is along its western edge, with an elevation of 500 feet. Where the Tennessee River leaves the county, the river is 350 feet above sea level.

*Railways and towns*—There are no railroads in this county. Saultillo and Hamburg are the only towns of any importance west of the river, both are on the Tennessee River, the former in the northern part of the county, and the latter near the south. Savannah is the county seat.

*Geology*—The Eutaw sands, Selma clay and Lafayette formation outcrop in this county. Along the river are the Paleozoic limestones, then comes a narrow band of Eutaw sands, from 3 to 8 miles wide, while along the western border the Selma clay outcrops. The surface is covered with a thin blanket of Lafayette.

*Clays*—This county was not visited and no white clay deposits heard of. Along the river the decay of the limestones should yield a surface clay suitable for brick.

#### HAYWOOD COUNTY.

*Topography*—This county is situated just southwest of the center of this area. It is bounded on the north by the South Fork of the Forked Deer River. The county has an area of 520 square miles. The surface is a slightly rolling plain, with a gentle slope towards the Hatchie and South Fork of the Forked Deer River. The divide between these two streams runs directly through Brownsville, which is 344 feet above sea level. No deep ravines are found. The average elevation is 325 feet.

*Railroads and towns*—The Louisville & Nashville Railroad traverses the county, from the northeast corner to the southwest corner. Brownsville, located on it, is the county seat, and only town of any importance in the county.

*Geology*—The county is entirely underlaid by the LaGrange formation. This is covered by the Lafayette sands and clays in nearly every place. The Lafayette formation is from 10 to 20 feet thick, and in turn is covered by a light loam, which in the western part of the county changes to loess. This is from 5 to 10 feet thick.

*Clay*—The dark orange clays of the Lafayette are the only ones used here now for brick making. The LaGrange is covered too deeply to be exploited.

*Brownsville*—A brick plant is located here, which is owned by McKnight Brothers, of Humboldt. The plant is located just south of town, on the Louisville & Nashville Railroad.

The clay is gotten from the Lafayette formation, but is stiffer and will stand more heat than that which is used at Humboldt.

The clay is brought by a cart to a horse-power chaser tempering wheel. After a thorough working it is left to stand for 24 hours. The bricks are then hand molded, placed in racks, under sheds having a capacity of 150,000 and dried for about 8 days. There are three up-draft kilns (Dutch), of 240,000 capacity, which use a burning system patented by John C. Bass. This is an underground air system. The

air is forced up under the grates on which slack coal is used. An electric motor is used to turn the blower. The brick are burned for 8 days. The whole process of making brick occupies 6 weeks.

Only hand molded brick are made, which supply a wagon trade for a radius of 20 miles. In 1910 850,000 brick were manufactured.

## HENDERSON COUNTY.

*Topography*—This county is situated just west of the center of the area under discussion. It has an area of 515 square miles. The Mississippi-Tennessee Divide crosses the county, running north and south. It has an elevation of 600 feet in places. The surface is very hilly along this divide and the eastern slope. On this slope the streams are rapidly cutting the surface. The principal river is the Beech River, which drains into the Tennessee. The western slope is cut up, not as badly as the eastern.

*Railroads and towns*—The Nashville, Chattanooga & St. Louis Railway comes down from the north to Lexington, the county seat and most important town in the center of the county. Here it turns southwest to the southwest corner of the county. A branch line also runs directly east from Lexington to the Tennessee River.

*Geology*—This county has more formations outcropping in it than any other county in West Tennessee. On the eastern edge is a strip of Eutaw sands, then comes a band of Selma clay; through the center of the county the Ripley extends as a band about 10 miles wide, while west of it the Porter's Creek outcrops, and in the northwest corner is a small area underlaid by the LaGrange. The whole county is covered by a thin blanket of Lafayette sands and clays, not more than 20 feet thick in any place.

*Clay*—No lenses of clay of good quality have been found in the Ripley sands in this county. The only clay used economically is that from the Lafayette formation, which is used in a few places for making brick and tile.

*Lexington*—Mr. J. C. White has stripped about 3 feet of red Lafayette clay for making a rough brick for 20 years. The clay is mixed and ground by tempering wheels, running in three circular pits. Six thousand bricks a day are hand molded, then sun dried for several days, and then burned with wood for ten days in a Scove kiln.

Last year 200,000 brick were made and sold locally. When out-of-town contracts are made, instead of shipping brick, a temporary plant is set up at the town and the brick made there. North of town on the road to Alberton, in a road cut about 5 miles from Lexington, a light yellow loamy micaceous clay was found. This clay is a phase of the Ripley

formation that occurs in streaks in places. It looks greatly like an outcrop of the Porter's Creek formation and is easily mistaken for such.

Most of the exposures on the road to Alberton are of a dark orange sand, which for short distances is banded orange and white sand. This is particularly the case near Alberton, where the large hill is composed of such layers, in which the white predominates.

Four miles from town on the road leading to Scott's Hill, 8 feet of white sand are finely exposed, overlaid by 2 feet of light orange sand. Just beyond here the road commences to go down to Piney Creek. (For section of this exposure, see p. 12.)

Seven miles from Lexington on this same road a good exposure of the Selma clay was found. There are 6 feet of greenish micaceous clay, with shells scattered through it, which were overlaid by 4 feet of light orange sandy clay. Another exposure near here on the old road is given on p. 14.

At Scott's Hill, on the road entering town from Lexington, a fine exposure was found, which was described on p. 13.

On the road 3 miles west of Scott's Hill, on the edge of Cane Creek bottoms, Mr. B. F. McClanahan has started a brick and tile plant.

The clay is gotten from the surface and is used down for 4 or 5 feet. The clay is used in a stiff mud steel machine of the auger type, with a capacity of 8,000 daily. The die can be changed and 4-inch tiles made instead of brick. This clay is dried several days, and then burnt in a Scove kiln. The burning is done by wood, and takes 8 to 10 days. The kiln holds 75,000 brick.

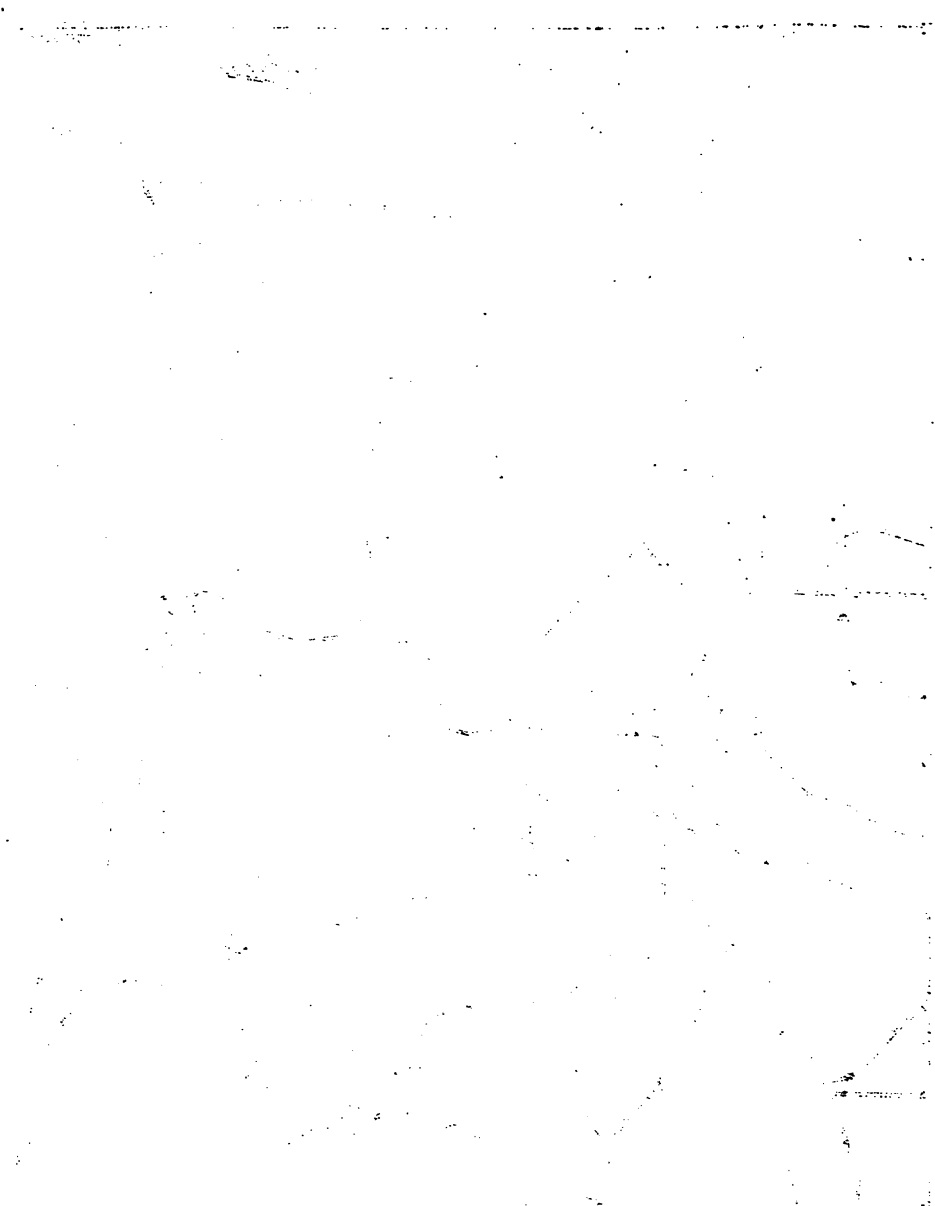
Three miles north of Lexington, on the Huntingdon road, there is said to be a bed of light grey and pink sandy clay. It is covered by 2 to 8 feet of dark orange sand.

#### HENRY COUNTY.

*Topography*—This county lies in the northeast corner of West Tennessee. It is bounded by Kentucky on the north and the Big Sandy and Tennessee rivers on the east. The county has an area of 625 square miles.

The Mississippi-Tennessee Divide runs through the center of the county from north to south and divides it in half. The middle and north forks of the Obion River drain the west and the Big Sandy and Tennessee rivers the east part of the county. Along the divide the county is broken and hilly, the headwaters of the stream having made many gullies. East of the divide the slope is steep, but not as hilly, while west of it the slope is more gentle, and the surface changes to a

2707  
vsa 981 980 981 8



nearly level plain. In places, as in the northwest corner, the surface is greatly eroded. The highest part of the county is along the divide, where in places it reaches 600 feet. The average elevation is 500 feet, while the lowest is 300, where the Tennessee River leaves the county.

*Railroads and towns*—The Nashville, Chattanooga & St. Louis goes directly through the center of the county from north to south, and the Louisville & Nashville enters in the southwest corner, crosses the Nashville, Chattanooga & St. Louis at Paris, then goes due east and out of the county.

Paris is the county seat and largest town. It is located in the center of the county on both railroads. There are no other towns of any importance.

*Geology*—On the eastern edge of the county is a strip a few miles wide, where the Paleozoic limestones outcrop. West of this the Ripley formation outcrops in a band about 5 miles wide, which is bordered on its west by the Porter's Creek clay, which is about 4 miles wide. The western edge of this bed runs through the center of the county. West of this the remainder of the county is underlaid by the LaGrange sands and clays. The entire county is covered by a mantle of Lafayette, which is not more than 20 feet thick anywhere.

*Clays*—More white clays are worked in this county than all the rest of West Tennessee. The best pits are found along the eastern outcrop of the LaGrange formation, along the State line, and near the towns of Puryear, Whitlock, Paris and Henry. The other pits are found in the western edge of the Ripley formation near India.

These clays are good ball, wad and sagger clays, and are all shipped north to be manufactured into different kinds of ware.

*Cottage Grove*—Elevation 540 feet. All of this country is covered by several feet of Lafayette, with a band of concretionary iron and nodules at its base. Under that are the dark orange LaGrange sands, which gradually grade into a fine white sand, with narrow orange bands running through it. It becomes clayey at the base, and in places is underlaid by clay lenses of varying extent.

On the Bowden farm,  $\frac{1}{2}$  mile south of Cottage Grove, there is said to be a good outcrop of clay, which was hunted for, but not found.

On the Brizentine land, just north of town, are many deep gullies, which have exposures of 25 feet of a hard sandy clay, pure white. This clay, where it forms overhanging masses, has stalagmite-like pendants hanging from it, formed out of the clay, and caused by dropping in a somewhat similar manner to the stalagmites found in caves. This gives

the gullies the appearance of the limestone walls of the caves found in the central part of the State. This bed is covered by 4 feet of orange sand.

This clay has an appearance of a good fire clay, but is too far from transportation for present use. It is directly on the line of the proposed electric railway from Paris, Tenn., to Fulton, Ky.

In another gully, 100 yards further north, the following section was found:

*Section near Cottage Grove, Henry County.*

|                                                                                          | Feet |
|------------------------------------------------------------------------------------------|------|
| Lafayette:                                                                               |      |
| Light yellow clay, with iron .....                                                       | 2    |
| Nodules at base.                                                                         |      |
| LaGrange:                                                                                |      |
| Orange sand, hardened at base .....                                                      | 6    |
| White sandy clay, hard, changes to pink at the base, where a fossil leaf was found ..... | 15   |

It has joint planes, which run about fifty degrees west of north.

South of Cottage Grove, just below the blacksmith shop, is an exposure, in a small stream. The elevation is 480 feet. The bottom of the stream runs through a bed of poor lignitic material, which has been burned at times in the blacksmith shop. About 2 feet of it is exposed. It is overlaid by 15 feet of white sandy clay, and 5 feet of orange sand.

On the edge of town, on the Shankle place, some brick are being made by Mr. J. C. White, of Lexington, in a Scove kiln. Yearly capacity is 200,000. The surface clay from the Lafayette formation is used and mixed by a chaser tempering machine, and then hand molded.

This seems to be the western edge of the good clay lenses, and none are found west of a line drawn from here to Henry. The Mann pit is about 2 miles west of here. It is not worked at present.

*Henry*—On the road from Paris to Henry, 1½ miles from Henry, the following exposure was found.

*Section north of Henry, Henry County.*

|                                                       | Feet |
|-------------------------------------------------------|------|
| Lafayette:                                            |      |
| Clay, red sandy .....                                 | 5    |
| Clay, light orange, with a sprinkling of gravel ..... | 12   |
| Clay, white sandy .....                               | 20   |

This clay is plastic, but has too much grit and other impurities to allow its use for anything but saggers. This outcrop is near enough the railroad to be utilized, but there are so many better pits nearby that probably it would not pay to work it.



FIG. A. PIT NO. 10, JOHNSON-PORTER CLAY COMPANY.



FIG. B. PIT NO. 11, JOHNSON-PORTER CLAY COMPANY.

CLAY DEPOSITS IN LAGRANGE FORMATIONS NEAR HENRY.

SECRET

SECRET

11

Two miles east of Henry, just east of the Paris road, is an outcrop of clay in a stream bed. The clay is very plastic and cream colored. It is underlain by a bed of lignitic material. Above the clay is 12 feet of whitish sand, with a little clay in it, while above that the orange sands extend 38 feet to the top of the hill. This is too deep an overburden to be removed; the clay could not be worked economically for this reason.

*Johnson-Porter Clay Company*—This company has pits located about  $\frac{3}{4}$  mile above Henry on a spur track  $\frac{1}{4}$ -mile long. The offices are at Paris, Tenn., with Mr. Walter Johnson in charge. There are 2 pits located in 100 yards of each other—No. 10 and No. 11.

*Pit No. 10*—This pit is located right at the end of the spur track. The clay covers about 6 acres, and is a lens lying in the LaGrange formation. The thickness of the clay lens varies from 6 to 14 feet. (See Plate 12, Fig A.)

The following is a detailed section of the pit in its southwest side:

| <i>Section of Johnson-Porter Pit No. 10, Henry, Henry County.</i>                                                                                       |      |        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|
|                                                                                                                                                         | Feet | Inches |
| Sand, light orange .....                                                                                                                                | 5    |        |
| Sand, dark orange .....                                                                                                                                 | 5    |        |
| Sand, banded white and orange .....                                                                                                                     | 12   |        |
| Clay, dark brown, sagger .....                                                                                                                          | 1    |        |
| No. 10 ball clay, mottles pink .....                                                                                                                    | 5    |        |
| (Best in mine.)                                                                                                                                         |      |        |
| Lignite—grades into next .....                                                                                                                          |      | 2 to 6 |
| Dark brown sagger clay, in parts of the pit, it changes into cream or pink, while in the middle of the pit, they get a good ball clay—4 inches to ..... |      | 1½     |

The top bed, which is a dark brown sagger clay in the southwest corner of the pit, changes in the northeast corner to a good ball clay. The bottom bed also changes from a sagger to a ball clay. This clay has a fine smooth texture and conchoidal fracture. It is one of the best ball clays found in the United States, and is extremely plastic. No grit or sand is present, and on a very slight amount of iron, under  $1\frac{1}{2}$  per cent. Some of the beds also have enough organic matter present to give them a grey color, but this readily burns out, leaving a white ware.

The pit has now become so deep that the water is pumped out of it into a nearby gully. The surface is hilly and covered with a scattered growth of second timber. The overburden is a loose sand, which is easily removed by scrapers. At one time a steam shovel was used. The clay is dug by spades and picked over, different grades being made.

The dirty ball clays are graded as sagger or wad. The clay vitrifies at Seger cone 9, while that from most of the Henry County pits vitrifies at cone 8.

*Pit No. 11*—This pit adjoins No. 10 on the north side, being about 100 yards distant. The clay lens extends about 20° south of east, and covers about 3 acres, but at present only about 1 acre has been worked. The clay beds have a maximum thickness of 7 feet, which pinches down to 5 feet in places. The entire deposit is capable of being worked, as the overburden is not too thick in any place. It varies from 3 to 5 feet where worked. (See Plate 12, Fig B.)

The following is a section of the pit on east side:

*Section of Johnson-Porter No. 11 Pit, Henry, Henry County.*

|                                                                                                                                                                     | Feet |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Light orange sand, which changes into a white sand banded with orange streaks .....                                                                                 | 3-15 |
| Clay—mottled grey, used as sagger clay .....                                                                                                                        | 1-2  |
| Light grey ball clay, shipped as Tennessee ball clay No. 9. On the other side of mine it changes to a light pink and is shipped as Tennessee ball clay No. 11 ..... | 4-5  |
| Lignitic material .....                                                                                                                                             | 1    |
| Sagger clay, dark grey .....                                                                                                                                        | 3    |

On the other edges of the pit the clay which comes from the lower layer is shipped as sagger, on account of grit which is present. On the western edge orange sand like that above the deposit is found. The clay is dug with spades, after it has been loosened up by a charge of powder. It is sorted and placed on wagons and carried to the cars where it is loaded. The overburden is stripped off by scrapers and part of it placed in the pit where the clay has been worked out.

The clay is a fine ball clay, very plastic, conchoidal fracture, and very fine grained and smooth.

This pit was opened about two years ago, and is considered to be better than Pit No. 10.

The clay from both pits is all shipped away to be manufactured. The following is a list of firms using this clay partly in the manufacture of their wares: Buffalo Pottery Company, Buffalo, N. Y.; United States Electric Porcelain Company, East Liverpool, Ohio; Pittsburg High Voltage Insulator Company, Derry, Penn.; Mayer Pottery Company, Beaver Falls, Penn.; Hall China Company, East Liverpool, Ohio; Keinworth Tile Company, Newell, West Va.; Wheeling Tile Company, Wheeling, West Va.; Cooke Pottery Company, Kittanning, Pa.; Vodrey Pottery Company, East Liverpool, Ohio; C. C. Thompson Pottery Company, East Liverpool, Ohio; Shenango Pottery Company, New Castle, Pa.; Cartwright Brothers, East Liverpool, Ohio; Owen

China Company, Beaver Fall, Pa.; Ohio Porcelain Company, East Liverpool, Ohio; Sebring Pottery Company, Sebring, Ohio; Sanitary Pottery Company, Tiffin, Ohio; Universal Sanitary Manufacturing Company, New Castle, Pa.; Findlay Electric Porcelain Company, Findlay, Ohio; G. F. Brunt Porcelain Company, East Liverpool, Ohio; and Gem Clay Forming Company, Sebring, Ohio. The firms manufacture all kinds of china and table ware, electrical insulators and decorative tile, sanitary ware, gas tips, etc. (See Frontispiece.)

The clay is shipped over the Nashville, Chattanooga & St. Louis Railroad. Three hundred and twenty cars of clay were shipped in 1909, each car holding from 30 to 54 tons. Some years as many as 500 cars have been shipped. Up to date over 1,000 carloads of clay have been shipped from these two mines.

One mile southwest of Henry, on the Breedlove place, the old Nashville Pottery's pit is located. It has not been worked for several years. The following is a section of it:

*Section of Nashville Pottery pit near Henry, Henry County.*

|                                                                     | Feet | Inches |
|---------------------------------------------------------------------|------|--------|
| Dark orange sand, at the base banded streaks of white and orange    | 18   |        |
| Sand, light orange .....                                            | 2-5  |        |
| Iron pan .....                                                      |      | 1-2    |
| Sand, dark orange, cross-bedded .....                               | 5-12 |        |
| Sagger clay, white streaked with yellow iron stains in places ..... | 6-22 |        |

The clay lens is about 500 feet by 1,200 feet, and extends 30° west of north. The overburden does not increase to more than 20 feet in any place. This is very easy to remove, as it is composed of a soft, loose sand. The center of the old pit has been filled in with removed overburden.

The pit can be easily drained, as it is at the head of a ravine, into which the water will readily run.

The clay was shipped to the old Nashville Pottery Company, which has since then gone out of existence. It was used in making all kinds of stoneware. This clay could now be mined for saggars, and probably will soon be reopened. A lease is held on it by the Johnson-Porter Clay Company, Paris, Tenn.

On the same road, one-half mile further on, the pit of the Henry Clay Company, of Paducah, Ky., is located. This pit is 1½ miles southwest of Henry. Mr. J. C. Strop, of Henry, is in charge. The following is a section of the pit:

*Section of Henry Clay Company's pit, Henry, Henry County.*

|                                                   | Feet | Inches |
|---------------------------------------------------|------|--------|
| Clay, light grey, with pink spots in places ..... | 2    | 6      |
| Band of Kaolin .....                              |      | 3      |

|                                                                                                                   | Feet | Inches |
|-------------------------------------------------------------------------------------------------------------------|------|--------|
| Clay, grey or pink .....                                                                                          | 2    |        |
| Sand, light grey .....                                                                                            |      | 5      |
| Clay, dark grey, containing very numerous leaf impressions, this is called No. 3 clay .....                       | 3    |        |
| Sand, light grey .....                                                                                            |      | 3      |
| Clay, light grey, grades into a pink clay which is cream colored in spots. This is the best clay in the pit ..... | 3    | 6      |
| Then comes white sand.                                                                                            |      |        |

This bed is made up of many thin clay layers interbedded with bands of sand or some worthless clay. Some of the layers are full of organic matter, others are slightly stained with iron. The clays are mostly coarse. This pit has more separate layers of clay than any visited, and on this account is expensive to work, as so much picking over has to be done.

The pit is on the side of a ravine, but has not been dug down so that it will drain. The water has to be pumped out. The clay is known to extend back at least 50 yards further, and its present width is about 50 yards. The overburden is removed by pick and shovel, and put in the part of the pit already worked out. The clay is dug in the same way after it has been loosened by blasting. The dug clay is carried by wagons to Henry, where it is shipped away.

Only one grade of clay is shipped, which is used for the manufacture of stoneware.

Two and one-half miles south of here there is said to be a small band of kaolin 12 to 18 inches thick. Also east of Paris about 12 miles is a small bed of kaolin, 16 inches thick, with more than 20 feet overburden. Neither one of these deposits were visited.

*Palestine pit*—The clay in this pit is similar to that found in the old Nashville Pottery pit on the Breedlove place. It makes a good stoneware. This pit is only worked intermittently, and nothing has been done there recently.

There is a small pit one-half mile north of Henry which is leased by Mr. J. C. Strop from which cars of stoneware clay have been shipped. This clay is only a fairly good grade. No ball clay has been found there.

*Sparks' pit*—About 5 miles west of Henry, and directly north of McKenzie, on the road to Como, is the pit of Mr. C. Sparks' Pottery, which is located in McKenzie.

The pit is located on the east side of the road on a steeply sloping hillside, and has been dug back into the hill about 100 feet, with a width of 50 feet. At present the pit is one-half of the time filled with water;



FIG. A. PIT NO. 3, MANDLE-SANT CLAY COMPANY. GENERAL VIEW OF PIT.



FIG. B. PART OF PIT NO. 3, SHOWING BROWN CLAY AND ITS CONTACT WITH OVERLYING SANDS.

CLAY DEPOSITS IN RIPLEY FORMATION, NEAR INDIA.

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as the overburden taken from the pit has been dumped so as to interfere with the natural drainage into the nearby ravine. When visited, water was standing about 5 feet deep in the pit.

*Section of C. Sparks' pit.*

|                                                                                         |      |
|-----------------------------------------------------------------------------------------|------|
| Lafayette:                                                                              | Feet |
| Sand, light orange, darker at base and case-hardened, with a sprinkling of gravel ..... | 5-15 |

LaGrange:

Clay, white with pink streaks, flinty fracture with slight incrustation of a white crystalline substance along the cracks. Clay turns to dark brown at 12 feet and then back to white at base ..... 15

The overburden is so hard just above the clay that scrapers can not be used, so it is removed by picks in the same manner as the underlying clay.

The clay is hauled by wagon to the pottery, which is 6 miles distant at McKenzie.

*India*—About  $1\frac{1}{2}$  miles east of India is pit No. 3 of the Mandle-Sant Clay Company, St. Louis, Mo. (See Plate 13, Figs. A and B.)

The following is a section of the pit:

*Section of Mandle-Sant Clay Company, India, Henry County.*

|                                                                                                  | Feet | Inches |
|--------------------------------------------------------------------------------------------------|------|--------|
| Sand, light orange, soft and loose .....                                                         | 17   |        |
| Sand, black clayey film, tough .....                                                             | 1    | 4      |
| Clay, grey, water-stained in places. This clay is used .....                                     | 7    | 4      |
| Clay, black loamy, very brittle, pyrite and lignitized wood scattered through it, not used ..... | 2    | 8      |
| Clay, blue, very plastic .....                                                                   | 3    | 6      |
| Sand and dirty clay, yellowish, of no value .....                                                | 1    | 6      |
| Clay, brown, with a few small iron streaks, this clay is used ....                               | 2    | 6      |
| This clay grades into a bed of black clay which is not mined at present, thickness unknown.      |      |        |

The blue clay is the best in this pit, and contains the least amount of sand. This blue gradually changes into the brown bed which is beneath it, which is a fairly good ball clay. The intermediate clay is worthless and is thrown away. All these clays have a great amount of organic matter in them, which give them a dark color. In most cases this burns out.

The following is an analysis of the clay\*

*Analysis of Tennessee ball clay No. 3.*

Ultimate analysis.

|                |       |
|----------------|-------|
| Volatile ..... | 14.16 |
| Silica .....   | 48.72 |
| Alumina .....  | 32.89 |

\*Carl H. Zieme, Feb. 22, 1907.

## CLAY DEPOSITS OF WEST TENNESSEE.

|                  |      |
|------------------|------|
| Iron oxide ..... | 2.25 |
| Calcium .....    | .60  |
| Magnesium .....  | .65  |
| Potassium .....  | .98  |
| Sodium .....     | .14  |

---

100.39

## Rational analysis.

|                      |       |
|----------------------|-------|
| Clay substance ..... | 89.04 |
| Silica .....         | 9.64  |
| Feldspar .....       | 1.32  |

---

100.00

This analysis was made from an unwashed sample. The clay soaks up readily, and on sifting through a No. 12 lawn, a residue of from 10 to 15 per cent is left, which is mainly silica. Much of the iron is removed by the sifting. The clay is very plastic and will carry 72 per cent flint. When fired at cone 1, its shrinkage is 12.5 per cent, while it becomes 18 per cent at cone 8, at which heat it burns to a dense vitrified body of a greyish white color. It is very much like the English ball clays.

This clay lies on the western edge of the Ripley formation of Cretaceous age, in its upper part. The clay extends west from the edge of the pit for 400 yards. The overburden is a soft, loose sand, which is easily removed by scrapers, picks and shovels. The overburden gets thicker towards the west and probably reaches a thickness of 30 feet. At present the overburden is only 17 feet. The clay is mined by blasting first, then cut out with shovels and loaded on wagons and hauled to a nearby switch on the Louisville & Nashville Railroad. (See Plate 13, Figs. A and B.)

The clay is shipped to northern firms, some of which are: Lock Insulator Manufacturing Company, Victor, N. Y.; Hartford Faience Company, Hartford, Conn.; and Massillon Stone & Fire Brick Company. (See Frontispiece.)

One-half mile north of this pit is another small stoneware pit owned by the Mandle-Sant Clay Company.

The following section was gotten there:

*Section of Mandle-Sant clay pit northeast of India, Henry County*

|                                                                               | Feet | Inches |
|-------------------------------------------------------------------------------|------|--------|
| Orange sand .....                                                             | 2    | 6      |
| Gravel up to 2 inches in diameter; composed of quartzite and novaculite ..... |      | 10     |
| Light red sand .....                                                          | 2    | 6      |
| Clay bed brown at top, grades into a greyish blue to base of the pit .....    | 9    |        |

This pit is very small, only about 50 yards square. The overburden will increase up to about 10 feet as the pit is dug back. The pit will probably cover about 3 acres.

This clay is only used for stoneware. The pit will probably not be worked extensively, as the clay is of a poor grade for this territory.

*New Boston*—On the Hardin farm, one-quarter mile from New Boston, is a fine blossom of clay showing an exposure of about 10 feet. Borings in the center of the hill show an overburden of 30 feet of loose, orange sands. The lens covers about 110 acres, extending under the town and out on the other side of the Crawfords farm, and has a maximum thickness of 30 feet. This is directly along the line of the proposed interurban between Paris and Fulton.

This clay is very plastic and does not contain much grit. It is slightly stained with iron in places, and tests of burning from several samples have resulted in ware that is within grey in color. At present this deposit is too far from a railroad to be used. The nearest point is Paris, which is about 7 miles.

*Paris*—On the eastern edge of town is a brick plant owned and operated by Mr. Gatlin. The Lafayette clays are used down for several feet, the surface being discarded. The clay is tempered in an upright pug mill run by a horse. It has a capacity of 20,000 a day. The clay is hand molded and burned for 8 or 10 days in a Scove kiln, using wood. (See Plate 5, Fig. A.)

One and one-half miles east of Paris is another small brick kiln, exactly like the preceding. Brick are made only for local use.

*Currier pottery and pits*—Mr. J. T. Currier has two potteries near Paris, which have not been operated for several years. The principal plant is on the Louisville & Nashville Railroad about 1½ miles north-east of Paris. A pug mill was used for grinding and tempering the clay, and had a capacity of 11,000 a day. Two kilns were used, one a downdraft 16 feet inside diameter, with a capacity of 3,000 gallons; the second is a patent Howard kiln, with a capacity of 2,000 gallons. The downdraft kiln used coal and the Howard kiln used wood. The second pottery is half a mile east of the other, and has one downdraft kiln with a capacity of 2,000 gallons.

The ware made was mainly jugs. There is no longer a large demand for jugs, as at present glass bottles are taking their place in the bottling of whisky\*

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\*Stoneware and brick clays, West Tennessee, by E. C. Eckel, U. S. Geol. Surv. Bull. No. 213.

The Currier pits are located about 1 mile east of the principal pottery. Below is a section:

*Section of Currier pits, east of Paris.*

|                                       | Feet | Inches |
|---------------------------------------|------|--------|
| Loam, light yellow .....              | 2-3  |        |
| Gravel .....                          |      | 1-3    |
| Clay, sandy, yellowish .....          | 1-3  |        |
| Clay, greyish, not very uniform ..... | 5    |        |

This pit was not visited, but it would seem from the other pits visited nearby that the clays found here are of the Ripley formation of Cretaceous age.

*Puryear*—There is a pit located one-quarter mile south of town on the west side of the Nashville, Chattanooga & St. Louis Railroad. It is leased by the Mandle-Sant Clay Company, St. Louis, Mo.

*Section of Mandle-Sant Clay Company's pit, at Puryear.*

|                                                                                                                                                                                                                   | Feet |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Sand, orange, mostly gravel about 2 feet in diameter, with a few boulders over 1 foot in diameter scattered through it. The gravel is composed of quartzite and novaculite. There is an iron streak at the base.. | 5    |
| Clay, white sandy, with yellow tinge, very hard. Has outward appearance of stalagmites where water has dripped over it .....                                                                                      | 16   |
| Clay, light grey, full of leaf impressions. This is a plastic clay and has little sand present .....                                                                                                              | 8    |
| Clay, yellowish white. No fossils, very plastic .....                                                                                                                                                             | 5    |

The top part of the grey clay is shipped as Tennessee ball clay No. 2, and is used for pottery. The middle of the grey clay is called Tennessee ball clay No. 3, and is less plastic than No. 2. It is used for tiles. While the lower part of the grey clay is called Tennessee ball clay No. 4, and is very brittle, being the poorest clay found here. The lower bed of yellowish white clay is shipped as Tennessee ball clay No. 5, and is used for saggers.

The No. 2 is the best clay. This pit was opened about 1904. It is drained from its western edge, the water being pumped out of the deepest parts by a small engine.

From the shape of the hill the clay lens must cover about 5 or 6 acres. The present pit only covers about an acre. The overburden should be easily removed, as the gravel can be sold for ballast, and the white sandy clay for fire brick to the plant just across the railroad track. Both of these beds could be utilized, and should pay for their removal.

The clay has been shipped north for use in the making of china-ware and insulators. The Dixie Fireproof Brick Company is situated across the track from the pit. Mr. Thomas H. McElrath is in charge. The plant was started in 1905. No brick have been manufactured for the last two years. The clay was gotten from the pit across the track

and ground in a machine run by steam. The capacity was 50,000 a day. The bricks were dried in summer outdoors, while in winter steam heated drying rooms were used. There are two downdraft beehive ovens, 25 feet in diameter, and 8 feet high to the arch. The kilns were burnt with coal.

Two miles south of Puryear is a pit worked by Mandle-Sant Clay Company. There is no gravel on top. Orange sand of the Lafayette is present with a little gravel; then comes the fine white sand of the LaGrange formation. It is streaked in places with yellow, and case-hardened; then comes the clay bed 6 feet thick, which is dark grey, with fossil leaves scattered through it.

The Cosley Clay Company, of Mayfield, Ky., has a pit just south of the State line and 5 miles west of the Nashville, Chattanooga & St. Louis Railroad. The clay is shipped from Hazel, Ky. This was not visited.

*Whitlock*—There are five important pits located here, four belonging to the Mandle-Sant Clay Company, of St. Louis, Mo., and the other to the Tennessee Ball & Sagger Clay Company of the same place.

*Pit No. 7*—This pit is owned by the Mandle-Sant Clay Company, and is situated nearly three miles northwest of Whitlock. The pit covers several acres, and is the largest one in West Tennessee. (See Plate 14, Fig. B.) The whole clay lens has an area of 10 acres. The clay reaches a maximum of 8 feet and thins out from that towards the edges, where it disappears.

The following is a section of the pit on the south side:

*Section of Mandle-Sant Clay Company pit No. 7, near Whitlock,  
Henry County.*

|                                                                          | Feet |
|--------------------------------------------------------------------------|------|
| Orange sand, banded towards its base with sandy clay bands (12 feet).... | 25   |
| Clay, reddish brown .....                                                | 2    |
| Clay, pink .....                                                         | 2    |
| Clay, sagger .....                                                       | 1    |
| Clay, grey, with organic matter present. This is the best clay .....     | 3    |

In the southwest corner all the clay is grey, with the exception of a band of pink about 1 foot thick above it. This grey clay is divided into two grades, a plastic and a nonplastic clay. The sagger clay, found under the pink, has a good binding quality, but too much iron.

The clays are shipped as follows:

- Light grey clay—Tennessee selected ball clay No. 1
- Mixed dark grey clay—Tennessee ball clay No. 1
- Pink clay—Tennessee selected ball clay No. 7.
- Mixed pink clay—Tennessee ball clay No. 7.
- Sagger clay—Tennessee sagger clay No. 7.

*Tennessee ball clay No. 1*—It is very plastic, and has a tensile strength of the average English Ball Clay. It will bind 65 per cent of flint. It vitrified to a close dense body of excellent color at cone 8, and then showed a shrinkage of 15 per cent.

The following are analyses of an unwashed sample:\*

*Analysis of Tennessee ball clay No. 1.*

Ultimate analysis.

|                  |       |
|------------------|-------|
| Volatile .....   | 13.94 |
| Silica .....     | 47.26 |
| Alumina .....    | 35.85 |
| Iron oxide ..... | 1.01  |
| Calcium .....    | .58   |
| Magnesium .....  | .68   |
| Potassium .....  | .74   |
| Sodium .....     | .45   |

---

100.51

Rational analysis.

|                      |       |
|----------------------|-------|
| Clay substance ..... | 93.04 |
| Silica .....         | 6.17  |
| Feldspar .....       | .79   |

---

100.00

*Tennessee ball clay No. 7*—This clay is very plastic and soaks readily in winter. It burns to a dense nonabsorbent body at cone 8, and at that point shows a shrinkage of 15 per cent. It burns to a white color, and is used in the manufacture of white ware and tiles.

The following are analyses of this clay:

*Analysis of Tennessee ball clay No. 7.*

Ultimate analysis.

|                  |       |
|------------------|-------|
| Volatile .....   | 10.92 |
| Silica .....     | 53.57 |
| Alumina .....    | 32.82 |
| Iron oxide ..... | 1.31  |
| Calcium .....    | .62   |
| Magnesium .....  | .38   |
| Potassium .....  | .59   |
| Sodium .....     | .21   |

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100.42

Rational analysis.

|                      |       |
|----------------------|-------|
| Clay substance ..... | 83.39 |
| Silica .....         | 14.78 |
| Feldspar .....       | 1.83  |

---

100.00

---

\*Carl H. Zieme, 1907.

This pit was opened in 1905 and has been worked since then continuously. The overburden is easily removed by a steam shovel. It is loaded on cars on a narrow gauge road and carried away and used for filling.

The clay is first blasted and then dug out with picks and spades and loaded on cars and taken to Whitlock. (See Plate 14 B.)

The mine is reached by a narrow gauge road about 3 miles long, which runs to Whitlock. It is owned and operated by the Mandle-Sant Clay Company. The rolling stock consists of 24 dump cars and two small engines. The clay is shipped to Victor and Buffalo, New York, and East Liverpool and Zanesville, Ohio. It is used as an ingredient in the manufacture of wall tiles, white ware, insulators and faience.

*Pit No. 4*—This pit is one mile northwest of Pit No. 7, and is owned by the Tennessee Ball and Sagger Clay Company, of St. Louis, Mo.

The following is a section of the pit:

*Section of Tennessee Ball and Sagger Clay Company, pit No. 4, near Whitlock.*

|                                       | Feet |
|---------------------------------------|------|
| Sand, orange, white at the base ..... | 5-10 |
| Clay, black lignitic .....            | 5    |
| Clay, dark grey .....                 | 6    |
| Clay, light grey .....                | 12   |

Then comes a white sandy clay which is not used.

This pit is about 200 feet long and has been dug back 150 feet. It is in the LaGrange formation of Eocene age. The overburden is a loose sand, and is taken by scrapers and dumped on the hillsides. The clay is blasted and then mined by hand and hauled by wagons to pit No. 7, where the clay is loaded on the dump cars and carried to Whitlock. This clay is shipped north.

No analysis could be procured of this clay, which is shipped as Tennessee Ball Clay No. 4. It is a very plastic clay, and burns to a dense white body at cone 8.

*Pit No. 9*—This pit is owned by the Mandle-Sant Clay Company, of St. Louis, Mo., and is located 1 mile southwest of Pit No. 7. It is about one-half mile east of the road leading to Paris, and a little over 3 miles west of Whitlock. (See Plate 14, Fig. A.)

The following is a section of the pit on the south side:

*Section of Mandle-Sant Clay Company's pit No. 9, near Whitlock.*

|                                                                      | Feet |
|----------------------------------------------------------------------|------|
| Sand, orange, lower part hardened and cross-bedded .....             | 4-20 |
| Lignitic material, brittle and light in weight, brown in color ..... | 3    |
| Ball clay, dark brown at top and light brown lower down .....        | 5    |
| Sagger clay, yellowish, with iron stains .....                       | 3    |

Under this is a white, very sandy clay, mixed with ironstone bands, which grades into a cross-bedded sandstone not very hard. All the clays are in the LaGrange formation of Eocene age. In places on the north side the lignitic material is replaced by a white sandy clay, which rests on the ball clay.

The clay vitrifies at seger cone 8, and has a total shrinkage of 16 per cent. It has very little free silica, a good percentage of feldspathic matter, and is very tough. It burns to a whitish grey, and closely resembles the English ball clay.

The pit covers about an acre. The overburden, which is mostly a loose sand, is removed by scrapers and dumped back of the pit. It will probably get 30 feet thick in places; the average is 15 feet. The clay is blasted and dug with pick and shovel, loaded on wagons and carried to the narrow gauge road at pit No. 7, and then loaded on the dump cars. It is shipped from Whitlock. The pit has a natural drainage toward the east into some nearby gullies. No pumping is necessary. The pit was opened in 1907, and has been worked since then, but in a desultory manner, and when visited only one man was digging there. The narrow gauge road is to be extended to this mine this year, and then operations will be opened up on a larger scale. The clays are shipped to the same places as that dug from pit No. 7.

*Pit No. 1*—This pit is three-fourth mile south of pit No. 9 and has been entirely worked out and was not visited. This is the oldest pit in the neighborhood.

*Monroe wad mine*—This mine is owned by Mandle-Sant Clay Company, of St. Louis, Mo., and is situated two miles north of Whitlock on the west side of the Nashville, Chattanooga & St. Louis Railroad.

This clay is one of the best wad clays offered to the trade, and is guaranteed not to "spit" or "fly" or stick to the saggars. It can also be used in the manufacture of architectural terra cotta. The following analyses have been made of it:\*

\*Carl H. Zieme, Feb. 22, 1907.



FIG. A. PIT No. 9, MANDLE-SANT CLAY COMPANY.  
Dark streak at left is a band of lignitic clay which changes in center of picture to a grey clay.



FIG. B. PIT No. 7, MANDLE-SANT CLAY COMPANY.  
Showing typical method of mining clay, and loading in dump cars.  
CLAY DEPOSITS IN LAGRANGE FORMATION, WEST OF WHITLOCK.

SECRET

*Analysis of Monroe wad clay.*

## Ultimate analysis.

|                  |        |
|------------------|--------|
| Volatile .....   | 8.80   |
| Silica .....     | 61.02  |
| Alumina .....    | 26.32  |
| Iron oxide ..... | 1.58   |
| Calcium .....    | .69    |
| Magnesium .....  | .83    |
| Potassium .....  | .65    |
| Sodium .....     | .18    |
|                  | <hr/>  |
|                  | 100.07 |

## Rational analysis.

|                      |        |
|----------------------|--------|
| Clay substance ..... | 49.67  |
| Silica .....         | 45.79  |
| Feldspar .....       | 4.54   |
|                      | <hr/>  |
|                      | 100.00 |

This clay is taken from a lens in the LaGrange formation of Eocene age.

*Jackson mine*—This is a small mine located two miles east of Whitlock, which is similar to the other pits around here. It was not visited.

*Routon*—On both sides of this place indications point to extensive deposits of good ball clay. No borings have been made.

*Vale*—One mile south of this place, on the Nashville, Chattanooga & St. Louis Railroad, is an outcrop of white clay in a railroad cut.

## LAKE COUNTY.

*Topography*—This county is situated in the northwest corner of West Tennessee, and lies between the Mississippi River and Reelfoot Lake.

It is a very small county, having an area of 128 square miles. The whole area is level, and has neither hills or ravines. Most of the area is subject to overflow, only having an elevation of about 300 feet. There is a slight southern slope to the county, being 315 feet high at the northern boundary and 290 feet on the south.

*Railroads and towns*—The only railroad in the county is a small branch line, called the Chicago, Memphis and Gulf, which runs to Tiptonville, the county seat, situated on the Mississippi River, and the only town of importance.

*Geology*—The whole surface is covered with alluvium from the Mississippi flood plain, which has a depth of about 100 feet, and is of recent age.

*Clay*—No clay products have ever been manufactured, and probably will not, as nothing could be used but alluvium, which would make a poor brick.

#### LAUDERDALE COUNTY.

*Topography*—This county is situated in the western part of West Tennessee, half way between its borders. It is bordered on the west by the Mississippi River, on the north by the South Fork of the Forked Deer River, and on the south by the Hatchie River. It has an area of 460 square miles. The western edge of the county lies in the Mississippi flood plain, and has an elevation of about 300 feet, and is perfectly flat, and subject to overflow. Then comes a line of steep bluffs from which the county extends backwards, deeply cut on the edges by the streams, while elsewhere the county is level or gently rolling. This plateau has an elevation of 350 feet. The South Fork of the Forked Deer and the Hatchie rivers have second bottoms several miles wide, which are about 15 feet above high water level.

*Railroads and towns*—One railroad, the Illinois Central, traverses the county through its central part, running north and south. The county seat and principal town is Ripley, which is on the Illinois Central, and in the center of the county. The only other towns of importance are Halls in the north, and Henning in the south, both on the railroad.

*Geology*—The LaGrange, Lafayette, loess, and alluvium, come to the surface in this county.

The LaGrange is rarely seen except along the base of the bluffs or in deep gullies or railroad cuts. Exposures were seen in the bottom of the railroad cuts at Ripley and Curve. At Curve the part exposed is a layer of dark blue lignitic clay below which is a fine quicksand.

The Lafayette here is mostly gravel or coarse sand, on account of the nearness to the Mississippi River. It overlies the LaGrange except in the bottoms where it has been washed away. It in turn is overlaid by the Columbia loess.

The Columbia loess extends over the county as a mantle, having a thickness of about 20 feet.

*Clay*—The only clay used is the loess, which is utilized in the making of brick in favorable places.

*Ripley*—Brick are manufactured here by F. M. McCabe & Co., of this place, who have been in operation three years. The plant is located on the south edge of town. The clay is taken from a pit by the side of the plant, and is used from the surface down to 25 feet, becoming better as it goes down. The clay is run through a disinte-

grator, which is a crusher with two large wheels, and then placed in a Hercules (soft mud) machine, which has a capacity of 35,000 brick daily. Some of the brick are repressed by a hand machine, which has a capacity of 2,000 a day.

The brick are dried out doors for one week in sheds which have a capacity of 129,000. They are burned in updraft kilns. There are two kilns of this type, which have a capacity of 500,000 and 400,000 each. Wood is used for drying and coal for burning, the whole process taking 14 or 15 days.

Common soft mud brick are made, and are nearly all used locally. A few are shipped. In 1910 they made 1,600,000 brick.

#### MADISON COUNTY.

*Topography*—This county lies just south of the center of West Tennessee, and has an area of 545 square miles. The county is drained primarily by the South Fork of the Forked Deer River. The western part of the county is level, the central part gently rolling, and the eastern and southern parts very hilly and broken. On the divides between the streams an elevation of 500 feet is reached, while, where the Forked Deer River leaves the county, the land is 315 feet above sea level. The average elevation is 450 feet.

*Railroads and towns*—Three railroads traverse the county, the Nashville, Chattanooga & St. Louis, the Illinois Central and the Mobile & Ohio. The latter two run through the county from north to south and cross at Jackson. The Nashville, Chattanooga & St. Louis Railroad also passes through Jackson, and runs through the county from east to west, leaving the county in its southwestern corner. Jackson is the county seat, and largest town, and is located at the junction of the three railroads. There are no other towns of any importance.

*Geology*—The Porter's Creek, LaGrange and Lafayette are found in this county. The Porter's Creek just enters the county in its southeastern corner, and runs along its edge from the point where the Nashville, Chattanooga & St. Louis enters to just north of where the Mobile & Ohio leaves the county. All the rest of the county is underlaid by the LaGrange formation, while the whole county is covered by a thin blanket of Lafayette sands and clays, which will not exceed 20 feet.

*Clay*—The clays of this county that are utilized come from the Lafayette and LaGrange. The Lafayette clays are only used for making common brick in a few of the towns, while the lenses of light colored clays from the LaGrange are utilized in several potteries and in one

fire brick plant. No pure ball clays are worked here, all the lenses having clays which give a dark burn, but there are indications in several places that good lenses of ball clay might be developed. Outcrops have been found which give promise of better things under the hills.

*Gilmore*—The Southern Tile & Brick Works are located here on the west side of the Mobile & Ohio. The main office is at Jackson, and following are the officers of the company: W. P. Hunt, President; R. B. Hicks, Vice President; L. X. Wickersham, Secretary. The company was organized in 1903, and is the largest and most complete fire brick plant in West Tennessee. (See Plate 6, Fig. A.)

The pit is located on the west side of the plant, and the following is a section taken from it:

| <i>Section of Southern Tile and Brick Works' pit, at Gilmore.</i> |  | Feet |
|-------------------------------------------------------------------|--|------|
| Clay, light orange sandy .....                                    |  | 6-15 |
| Clay, white, streaked with iron stain, (grades into) .....        |  | 4-12 |
| Clay, grey, which grades into black lignitic clay .....           |  | 34   |

The pit has only 25 feet of this bed exposed, but it has been found to extend down 9 feet deeper.

The clay is very plastic, and has a slight gritty feel. The following analysis was gotten of it from Mr. X. B. Wickersham:

*Analysis of clay at Gilmore.*

|                    | Per Cent |
|--------------------|----------|
| Moisture .....     | .98      |
| Silica .....       | 77.83    |
| Alumina .....      | 16.16    |
| Ferric oxide ..... | 2.86     |
| Loess .....        | 2.17     |
|                    | <hr/>    |
|                    | 100.00   |

Another analysis of a clay from this pit, probably the top layer, made by J. C. Wharton, of Nashville, in 1907, was as follows:

*Analysis of top layer of clay at Gilmore.*

|                                        | Per Cent |
|----------------------------------------|----------|
| Moisture .....                         | 5.60     |
| The dried sample then gave as follows: |          |
| Silica .....                           | 41.03    |
| Alumina .....                          | 11.40    |
| Ferric oxide .....                     | 5.71     |
| Calcium carbonate .....                | 35.71    |
| Magnesia carbonate .....               | 2.99     |
| Other substances unsought .....        | 3.46     |
|                                        | <hr/>    |
|                                        | 100.00   |

The black clay makes a white pressed brick, while a mixture of the brown and white clay makes a brown brick, while a strawberry red brick is made from a mixture of top red clay and white clay. The spotted brick are made by the addition of a little manganese. The fire brick will stand a heat of 2,800° Fahr.

The pit extends into the hill about 200 feet and is of about the same width. The overburden at present is about 10 feet, but it will increase to 25 feet where the hill is highest. Some of this can be used in a mixture with the white clay found underneath. The overburden is removed by scrapers to a small gully on one side, while the clay is loosened with powder, and then dug by hand and put in sheds to be used when the pit can not be worked.

The clay is first ground up in a heavy iron wheel in a dry pan, daily capacity of 35,000, and then passed through a sieve with one-sixteenth of an inch wire mesh. It is then run into the dry press machines, one a Burg press, with a daily capacity of 20,000, and the other a Reliance machine, with the same capacity, both being operated by steam and requiring four men each to run. The bricks go directly from the presses to the kilns.

There are nine kilns in operation, two updraft, with a capacity of 175,000 each, which take 20 days for a burn; seven downdraft, five with a capacity of 45,000 each, which are beehive in shape, have 12 "eyes," and require 8 days for a burn; two large ones, with a capacity of 175,000 each, which are rectangular, have 10 "eyes" to a side, and require 16 days for a burn. The drying out is done with wood and coke, and the burning with coal. It takes 20 cords of wood, 40 tons of coal and 10 tons of coke to burn a kiln of 175,000 brick. Several kinds of fire brick are made—the standard, split, side and bullhead size; also pressed front bricks of a light yellow mottled color and of a strawberry red. The daily capacity is 40,000 bricks. There is sold with the fire brick, ground fire clay, which is used to set them in, as no ordinary cement would do.

*Jackson*—J. B. Long manufactures common unpressed brick. The plant, which was established in 1904, is situated on the Nashville, Chattanooga & St. Louis Railroad on the southwestern edge of town.

The clay is used from the surface down to 3 or 4 feet. The surface is light yellow loam, while under it is the red Lafayette. These are mixed half and half in making brick. The clay is picked up, and then carried by scrapers to the nearby vats, where it is mixed with water and let stand over night.

A pugging machine of the chaser type runs in five pits, each with a capacity of 10,000 bricks, running three hours in each in succession.



PLATE 15.

W. H. L. G. O. N. H. G.

The brick are hand molded, then dried outdoors about eight days in racks, with a capacity of 18,000, then go to the kilns. There are three updraft (Dutch) kilns, each with a capacity of 350,000 brick. The kilns are 21 by 75 feet and require about five weeks for setting up, burning and cooling. The drying out with coke takes about seven days, and the burning, with wood and coal for 8 or 9 days, requiring 50 tons of coke, 90 tons of coal, and 25 cords of wood. They made 2,000,000 brick in 1910, most of which were sold in Jackson.

Two miles from Jackson, on the pike to Gilmore, the following road exposure was seen:

*Section in road near Jackson.*

| <b>Lafayette:</b>                                                           | <b>Feet</b> |
|-----------------------------------------------------------------------------|-------------|
| Cross-bedded orange sand, no gravel, overlaid by light mantle of loam ..... | 15-30       |
| White sandy clay to bottom of ditch .....                                   | 5-15        |

About 5 miles northeast of Jackson on the Brown's Church road a good road exposure of plastic clay was found. From the surface down to 6 feet was a light orange sandy clay with white sand bands, then came 4 or 5 feet of white sandy clay. At the bottom of the ditch on the east side of the road is a purplish plastic clay. The overburden on this clay should not exceed 20 feet in any place, as the hill under which it lies is low. Unless the clay should prove to be a good ball clay, it would not pay to work, as the deposit is over 4 miles from the railroad.

Two and a half miles from Jackson on the same road another road-side exposure was found, as follows:

*Section on road 2½ miles from Jackson.*

| <b>Lafayette:</b>                                             | <b>Feet</b> |
|---------------------------------------------------------------|-------------|
| Sand, light orange .....                                      | 5           |
| Sand, orange, case-hardened with band of iron at base .....   | 5           |
| <b>LaGrange:</b>                                              |             |
| Sand, white banded with orange sand, to bottom of ditch ..... | 2           |

On the Spring Creek road 2 miles northeast of Jackson an exposure of clay was found in a roadside ditch. Just the edge of the lens, which extends back east from the road under a low hill, is exposed. The clay is plastic, but sandy. It is overlaid by 6 to 8 feet of light orange sand hardened at the base with an ironstone pan, broken in places, and resting on the clay. The hill lies a few degrees east of south.

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PLATE 15.

WALL GROUND



On the edge of Jackson on the east side of the Spring Creek road the following exposure was found just beyond the bridge:

*Section at Jackson.*

|                                                                                                                                 | Feet |
|---------------------------------------------------------------------------------------------------------------------------------|------|
| Clay, light orange, sandy .....                                                                                                 | 5    |
| Sand, dark orange, with lignitic specks through it .....                                                                        | 12   |
| Clay, dark grey, soft at top, while at the base it is hard grey rock. A small amount of mica is scattered through the bed ..... | 30   |
| Clay, black, very plastic, looks like a ball clay, exposed to bottom of creek..                                                 | 4    |

The dark grey clay has all the characteristic marks of the Porter's Creek, but as it occurs about 12 miles west of any known outcrop, it could not be positively stated to be such, as there was not enough time available to trace it back to the main outcrops. It may be only a variation of the LaGrange formation.

*Malesus*—On the road  $1\frac{1}{2}$  miles east of this place the following exposure was found:

*Section east of Malesus, Madison County.*

|                                                  | Feet |
|--------------------------------------------------|------|
| Clay, light orange, sandy .....                  | 5-8  |
| Clay, white, sandy, extends under the hill ..... | 6-12 |
| Clay, dark, grey, sandy .....                    | 1-2  |
| Sand, orange, to base .....                      | 3    |

The hill extends about  $30^{\circ}$  west of south, and covers 4 or 5 acres. The clay may be a fire clay.

*Medon*—There is a road exposure 1 mile southwest of Medon. White sandy clay was found about 12 feet thick, which was covered by about 6 feet of orange sand. The clay is of a poor quality and has been used.

A good exposure was found in a gully on Mr. S. C. Whitfield's place, situated on the road  $2\frac{1}{2}$  miles northwest of Medon.

*Section northwest of Medon.*

|                                                                                                                              | Feet  |
|------------------------------------------------------------------------------------------------------------------------------|-------|
| Loam, light yellow .....                                                                                                     | 4-12  |
| Lafayette:                                                                                                                   |       |
| Clay, dark orange, sandy, no pebbles, case-hardened in places .....                                                          | 4-14  |
| LaGrange:                                                                                                                    |       |
| Clay, white, very sandy, running to bottom of ravine. It is mostly sand and is streaked with purple and pink in places ..... | 25-40 |

About  $\frac{1}{2}$  mile further on and west of the road, the following exposure was found in some gullies:

*Section 3 miles northwest of Medon.*

| Lafayette:                                           | Feet  |
|------------------------------------------------------|-------|
| Loam, light yellow .....                             | 4-6   |
| Clay, dark orange, sandy .....                       | 6-12  |
| Ironstone nodules up to the size of an orange .....  | 6     |
| LaGrange:                                            |       |
| Clay, white sandy, not very plastic .....            | 10-15 |
| Sand, loose, creamed colored, to base of gully ..... | 3     |

*Pinson*—The Pinson Pottery Company is located here on the west edge of town. Mr. J. A. Harris, of Jackson, is interested in it. The pottery has gone down greatly in the last few years, and at one time was shut down entirely, while at present it is only operating on a small scale. The plant was established in 1898, but before that potters' ware had been made here for 30 years. A few fire brick are made along with the pottery, the same clay being used for both. The clay is ground up in a crusher and then tempered by hand welding. Everything but the jars and jugs are made in plaster of paris molds, though at present churns are made on a potters wheel, as well as the jugs and jars. These wheels at present are run by foot power, though they are fixed to be run by steam if so desired.

The following ware is made: Pitchers,  $\frac{1}{2}$ , 1 and  $1\frac{1}{2}$  gallons; chicken founts, 1 gallon; jars, 1 to 10 gallons; churns, 1 to 6 gallons; bowls,  $\frac{1}{2}$  to 2 gallons; flower pots, 4 to 14 inches in diameter. No jugs are made at present, as they were used in shipping whisky, which is now bottled in glass.

Seven pounds of clay are used for 1 gallon vessel, which when dried weighs 6 pounds, and when burned  $5\frac{1}{4}$  pounds, this showing the presence of 25 per cent of water in the green ware. A 2 gallon vessel requires 11 pounds of clay, a 3, 4, 5, 6, 7, 8, and 10 gallon require respectively,  $15\frac{1}{2}$ , 18, 22,  $23\frac{1}{2}$ , 32 and 38 pounds of clay.

The ware shrinks 1 inch to the foot, which is allowed for in its making. The drying is done in a room 100x13 feet, holding 5,000 gallons, which is heated by flues from three fire boxes at one end, using wood. After dipping in a slip of feldspar, ground flint and clay, the ware is put in two downdraft kilns (Stewart patent), one 18 feet in diameter, holding 6,000 gallons, the other 25 feet, holding 8,500 gallons. The burn takes 72 hours. Only the small kiln is now used, requiring 10 tons of coal.

Most of the ware is shipped south, some going as far as New Orleans.

The clay is obtained from about 3 miles west of Pinson, near Bear Creek. The following section was taken at the pit:

*Section of Pinson pit, near Bear Creek.*

|                                                                                      | Feet |
|--------------------------------------------------------------------------------------|------|
| Clay, red, sandy .....                                                               | 2    |
| Ironstone pipes mixed with a light orange sand .....                                 | 12   |
| Sand, cross-bedded, orange and white bands .....                                     | 12   |
| Clay, dark grey, plastic, with lignitic specks in it, extends to bottom of pit ..... | 20   |

The hill runs 20° east of south, and covers about 4 acres. This pit has been dug down nearly to stream level, but natural drainage has been cut off by the method of handling overburden. The overburden is about 30 feet, and will increase to over 40 feet if the pit is dug back further. It is easily removed except where the iron pipes are cemented together. The clay is dug by hand and hauled to Pinson by wagons. The road is over 3 miles and very poor.

The clay is very plastic, of a light grey color, very similar to the lower layer of clay found in the pit at Gilmore, of the Southern Tile & Brick Works. It lies in the LaGrange formation of Eocene age. The following exposure was seen on Mr. Davis' land about 1½ miles south of the Pinson Pottery Company pit on the west side of the road:

*Section of Davis' land, near Pinson pits.*

|                                                                                                                          | Feet |
|--------------------------------------------------------------------------------------------------------------------------|------|
| Lafayette:                                                                                                               |      |
| Clay, light orange, cross-bedded, sandy with clay pellets in it.....                                                     | 6-8  |
| Iron pipes .....                                                                                                         | 1    |
| Clay pellets, white, sandy, up to one foot in size held together by a light orange sand, in which mica was present ..... | 12   |

This exposure shows that the original bed here had been eroded and that the pellets from it were deposited together with sand in the formation of another bed.

The Davis pit is nearly 2 miles south of the Pinson pit, and about 100 yards west of the road of Mr. J. T. Fields' land. The following section was found:

*Section on Fields' land, northwest of Pinson.*

|                                                              | Feet |
|--------------------------------------------------------------|------|
| Sand, light orange, cross-bedded, with pellets at base ..... | 4-5  |
| Clay, greyish white, a little sandy .....                    | 20   |

This clay has sometimes been used by the pottery, but it was not quite plastic enough. The clay may make a fire brick, as it seems to have about the right physical properties. The overburden is hard in places, and will reach a maximum of 25 or 30 feet on top of the hill, but could be removed by picks. There is a good supply of water in the nearby streams.

Mr. J. L. Allen's pit is located on the Medon road,  $2\frac{1}{2}$  miles from Pinson. A light grey, plastic clay was found which is slightly sandy. It has an overburden of 12 feet of orange sand to the level of the road, while on the other side of the road the hill extends up 10 or 15 feet higher. This clay is one of the best near Pinson, and could be easily hauled there, as there is a good road all the way. It is not a ball clay.

On this same road, 2 miles from Pinson, on J. L. Allen's land, the following roadside exposure was seen:

*Section on Allen's land, southwest of Pinson.*

|                                                                           | Feet |
|---------------------------------------------------------------------------|------|
| Clay, light yellow, micaceous, loose and soft. Cross-bedded at the base.. | 10   |
| Sand, greenish, micaceous, with small amount of Glauconite .....          | 2    |

Both west and east of the exposure other road cuts show only a red cross-bedded sandy clay, which in places has gravel mixed in it. The gravel is composed mostly of quartzite, and is not larger than  $\frac{1}{2}$  inch in diameter.

From this it seems that the green sand and micaceous clay belong to a tongue of the Porter's Creek formation which extends up from the southeast where the main band lies. The green sand might be used as a fertilizer for the farms, as it has a small per cent of potash present.

#### McNAIRY COUNTY.

*Topography*—This county is situated in the southeast corner of West Tennessee, and is bounded on the south by the State of Mississippi. It has an area of 570 square miles. The Tennessee-Mississippi Divide crosses the county from north to south, giving a third of the county to the Tennessee drainage and the rest to the Mississippi. This divide has an elevation of about 600 feet. The general surface of the county is about 475 feet above sea level. The surface is hilly in the west and southwest, while the east is more level.

*Railroads and towns*—The Mobile & Ohio crosses the county through its center from the north to south. Selmer is the county seat and only town of any importance.

*Geology*—Along the southeastern edge is a very narrow band of Eutaw sands, not extending more than a mile and a half into the county; next comes a band of Selma clay, about 8 miles wide, along the whole eastern edge, while the western half of the county is covered by the Ripley formation, with the exception of a few square miles in the northwest corner, where the Porter's Creek beds outcrop. The Lafayette covers the Ripley, but has been eroded away from most of the Selma clay.

*Clays*—The only clay used is that from the Lafayette, which is used in the manufacture of brick. Prospecting along the western edge of

the county in the Ripley formation would probably bring to light some lenses of ball or potters' clay.

*Selmer*—No clay brick are made here, but Gooch & Harris, make a Sanderson patent brick, which is really a cement block colored red. The sand with which the brick is made is gotten from the Ripley formation. They have a daily capacity of 4,000 and made 30,000 last year. They are sold from \$9.00 to \$15.00 a thousand. None are shipped.

#### OBION COUNTY.

*Topography*—This county is in the northwestern part of West Tennessee next to Kentucky. It has an area of 505 square miles. A belt along its eastern edge a mile or two wide is low and subject to overflow, and the same is true of land on both sides of the Obion River, except drainage work has been done. Back from the Obion River is a second bottom 25 feet higher than the flood plain, which extends back several miles. All the rest of the county is much higher and changes from rolling to very hilly. The most hilly portion is just back of Reelfoot Lake—which is about 275 feet above sea level. The land is highest in the northern part of the county, where it reaches a height of 400 feet. The general elevation is about 350 feet.

*Railroads and towns*—Three railroads cross this county, the Nashville, Chattanooga & St. Louis traversing the northeastern corner, the Mobile & Ohio running along the eastern border and the Illinois Central coming in the northwest corner and going out in the south central part. This gives to the eastern section abundant railroad facilities and leaves the entire western part of the county destitute of facilities.

Union City is the county seat and most important town. It is located in the north central part of the county, at the junction of the Mobile & Ohio and Nashville, Chattanooga & St. Louis railroads, while the Illinois Central crosses the Nashville, Chattanooga & St. Louis only 3 miles from there at Gibbs. Other towns of importance are Obion and Kenton, both in the southern part of the county—the former on the Illinois Central, the latter on the Mobile & Ohio—and Rives in the central part, where the Illinois Central and Mobile & Ohio cross.

*Geology*—The formations found here are the LaGrange, Lafayette, Columbia loess and Alluvium. The LaGrange is covered everywhere except along the base of the lake hills. It is very clayey, but is too deep to be worked, as the clay is not of a high grade.

The Lafayette is found on the surface in the eastern part of the county in the uplands only. It is 20 to 30 feet thick, and is composed mostly of sand and gravel, the latter being very abundant near the river.

The Columbia loess lies as a mantle over the whole western half of the county, except in the bottoms it has been washed away and replaced by alluvium, as in the Obion and Reelfoot swamps. The loess is from 25 to 75 feet thick and lies on the Lafayette in the uplands, while in the second bottoms it rests directly on the LaGrange.

*Clay*—The only clay utilized here is the loess, of which two varieties are found and used. The light loess for brick and the dark for drain tiles, the latter being very plastic.

*Obion*—The W. M. Fox Tile Company, established in 1895, manufactures brick and drain tile. The loess is used to a depth of about 8 feet, below that it becomes too tough. The black and light yellow loess are mixed for making tile, while the light yellow is used alone for brick. The clay is taken directly to the stiff mud machine, which has a capacity of 15,000 a day, and is a combination machine for making brick or tile. The tile can be made from 4 to 14 inches in diameter. The bricks are dried in outdoor sheds, for about a week and then taken into the kiln.

Two downdraft beehive kilns are used, each with a capacity of 30,000. The kilns require three days for a burn, and wood or coal is used according to which is most convenient. When in operation the plant requires fifteen men. The tile are sold according to their size from \$17.00 to \$100.00 a thousand, while the brick bring from \$5.50 to \$7.50 a thousand. Most of the brick and tile are used locally.

*Rives*—The Rives Tile Company is located here, and is owned by the Foxes of Obion. It is operated by Mr. D. H. Woody, of this place.

A Keels' stiff mud combination machine for making either brick or tile is in use. It has a daily capacity of 15,000 brick.

In other respects the plant is like the one located at Obion.

*Union City*—The Union City Tile Factory, owned by Mr. R. M. Whipple, is located here on the Mobile & Ohio Railroad. This is the only special tile plant in West Tennessee, and it has been in operation for 35 years. It employs 26 men when in operation. The tile is made from a black loess, gotten from the side of the yard, which is dug down to 6 feet.

A stiff mud machine (No. 9 A) is used, which has a daily capacity of 10,000 4-inch tile. The tile are dried for 6 or 8 days, in three sheds, holding 10,000 4-inch tile. They are then burned in five downdraft beehive kilns 30 feet in diameter and 8 feet to the arch. Each holding 15,000 4-inch tile. Coal is used in the burning, which occupies 65 or 70 hours.

The T. L. Bransford & Sons' plant, in the northeast corner of the town, uses light yellow loess mixed with dark, gotten from the side of the yard, where it is dug to a depth of 6 feet.

The clay is soaked for 24 hours in two vats 12 by 30x4 feet, each holding material for 21,000 brick. It then goes by a belt conveyor to a Martin soft mud brick machine with a capacity of 21,000 a day. After air drying a week they are burned in Scove kilns 60 to 30 feet, holding 300,000 each for 13 to 15 days, using wood. The selected brick are shipped in a radius of 150 miles.

#### SHELBY COUNTY.

*Topography*—This county is situated in the southwestern corner of West Tennessee and is bounded on the west by the Mississippi River and on the south by the State of Mississippi. It has an area of 769 square miles. It is drained by the Loosahatchie and Wolf rivers. The county is low and swampy along the Mississippi River, except at Memphis, where the bluffs come up to the river. The two rivers also have flood plains several miles wide, and back of them a second flood plain about 20 feet higher, which is much more narrow than those found in Obion County. Three or four miles back of the Mississippi flood plain the bluffs which border the low plateau rise. This land is 50 to 75 feet higher than the flood plains, and is made up of gently rolling plains.

*Railroads and towns*—The following railroads converge from all directions at Memphis, on the Mississippi River, in the southwest corner of the county: Illinois Central, Louisville & Nashville, Nashville, Chattanooga & St. Louis, Southern, Kansas City, Memphis & Birmingham, and Yazoo & Mississippi Valley. Memphis is the county seat and also the largest city in the State, having a population of 131,105.

*Geology*—The county contains outcrops of the LaGrange, Lafayette, Columbia and Alluvium.

The LaGrange underlies the whole county. It is overlaid by the Lafayette in the uplands, and alluvium in the river bottoms. The Lafayette is not more than 30 feet thick, and in this locality is composed chiefly of gravel with some sands. Above it comes the loess which forms the river bluffs, and extends eastward, gradually thinning out and changing into a loam. The loess averages 50 feet in thickness along the bluffs. The flood plains are covered with alluvium, which reaches a thickness of 100 feet in places.

*Clays*—Only the loess is used in this county for making brick. No clay is being utilized from any other of the formations.

*Capleville*—The Nonconnah Pottery, located 1 mile east of Capleville, is owned and operated by Mr. W. B. Stevens. They make very

pretty, artistic ware, consisting of jardinières, jars and pitchers of various shapes. They are decorated with white enamel designs on a green base. After experimenting for several years, they started in 1909 to make ware on a commercial basis.

The local clay is gotten south of Capleville, just over the border in Mississippi. It is a light grey clay, which on burning turns to a light pink. In making the ware they mix with the local clay an imported red and white clay, with feldspar to make it tough. The ware after being molded is placed in a china ware kiln and burned to biscuit heat. It is then porcelain glazed and burnt under a temperature of 2,400° Fahr., which gives the ware a vitreous fracture. The decorative designs are burnt under a low heat.

*Memphis*—The Cubbins Brick Company, on the northeast side of town, has been in operation since 1890. The clay used is surface loess down to 4 or 5 feet. It goes from the pulverizer to the dry press machine, though in the summer some soft mud brick are made. They have two Fernel dry press machines of 20,000 daily capacity each, and one soft mud machine which has a capacity of 35,000 brick in 8 hours. The dry press brick are taken directly to the kilns and burned, while the soft mud brick are dried in racks out doors for a week before being burned. The racks have a capacity of 273,000.

They have seven updraft kilns, four with a capacity of 250,000 each, two of 400,000 each and one continuous kiln holding 400,000. The kilns are dried out with wood and coke, the process taking 8 days, then the bricks are burnt for 7 days with coal. Only two kinds of brick are made, a soft mud and a dry press brick.

*Tennessee Brick Company*—This company was established in 1890, and has been in operation since then. Recently it has been consolidated with the South Memphis Brick Company.

The surface loess has been used entirely, the first 6 feet for the dry press and the next 3 feet for soft mud machines. The bricks are made in dry press and soft mud machines. One hydraulic dry press of 40,000 daily capacity is used and two soft mud machines, which have a daily capacity of 31,000 each.

The kilns are of updraft variety and seven in number, having a capacity of 400,000 each. Wood and coke are used in drying the kiln and coal in the burning. The drying occupies 7 days and the burning 8 days. Most of the brick are sold locally, but a few are shipped to the surrounding towns.

*South Memphis Brick Company*—This plant is now consolidated with the preceding one, and manufactures the same class of brick.

Two Burg dry presses and two Success soft mud machines are in operation, the soft mud machines being used only in the summer, when

outdoor drying can be done. They have seven updraft kilns, which have a capacity of 550,000 each.

*Lyons Brick Plant*—C. B. Lyons & Son have a brick plant located in Memphis which was started in 1910.

The surface loess is used to a depth of 15 feet. This is made into bricks by a stiff mud machine—with a daily capacity of 30,000—and a Grand Automatic soft mud machine—with a daily capacity of 30,000. The brick are dried in outdoor sheds, which have a capacity of 75,000 brick. There are two kilns, one downdraft, with a capacity of 80,000, and one updraft with a capacity of 300,000. Wood is used for burning the kiln, which process takes 8 days in the downdraft and 2 weeks in the updraft. Slabs of wood from nearby mills are used.

At times drain tiles are made in the stiff mud machines out of mixture of one-half Grand Junction clay and one-half loess.

#### TIPTON COUNTY.

*Topography*—This county is just next to the southwest corner of West Tennessee. It is bounded on the west by the Mississippi and on the north by the Hatchie River. It has an area of 430 square miles.

The western edge of the county is on the Mississippi flood plain and is very low and marshy. The Hatchie River also has a flood plain several miles long, as well as a second bottom, which extends back a short distance from the flood plain. The rest of the county is about 50 feet higher and gently rolling or level, except at the bluffs, where there are many steep hills.

*Railroads and towns*—The Illinois Central Railroad traverses the center of the county in a north and south direction. Covington is the county seat, and only town of any importance. It is located on the Illinois Central Railroad.

*Geology*—The LaGrange, Lafayette and Columbia loess are found in the county. The LaGrange underlies the whole county, and is overlain by the red Lafayette sands and clays. The formations are identical with those of Shelby County, just south.

*Clays*—The Columbia loess is the only formation used in the manufacture of brick. Only one plant is located in the county.

*Covington*—Mr. R. B. Shelton has operated a brick plant here since 1895. The loess is used down for 5 or 6 feet, below which it becomes too tough. The clay is dug and run directly into a stiff mud machine, with a daily capacity of 20,000. They also have a dry press machine, but do not use it. There are two updraft (Dutch) kilns, each with a capacity of 300,000, and one downdraft kiln with a capacity of 50,000. The kilns are dried for 1 week with wood, and then the burning, which

occupies another week, is done with coal. The brick are used locally and shipped in a radius of 15 or 20 miles. Five miles south of here Mr. J. N. Rice makes clay pipes, using clay gotten 2 miles west of Covington, near Brighton, on the Illinois Central Railroad. The bowl of the pipe is made in a mold and then fitted to a cane stem.

#### WEAKLEY COUNTY.

*Topography*—This county is situated in the north central part of West Tennessee, and is bounded on the north by Kentucky, and on the south by the South Fork of the Obion River. Its area is 565 square miles. The surface is hilly around Dresden, and in the northeastern part of the county; the remainder of the county is gently rolling. Its general elevation is 425 feet, though in places 500 feet is reached, while in the west the Obion River is only 250 feet above sea level.

*Railroads and towns*—The Nashville, Chattanooga & St. Louis and Illinois Central cross the county, the former running from the northwest to southwest corner, while the Illinois Central runs north and south just a little west of its center. Dresden is the county seat, and a very prosperous town. Martin is the largest town in the county, and is located at the junction of the Nashville, Chattanooga & St. Louis and Illinois Central railroads. Other towns of importance are Gleason, Greenfield and Bradford.

*Geology*—The LaGrange, Lafayette and Columbia loam are found here. The LaGrange underlies the entire county. It is overlaid by about 20 feet of Lafayette formation, which here consists mostly of a red clayey sand, which in turn is covered in most places by a thin mantle of loam, 5 or 10 feet thick, while it is very similar to the loess.

*Clay*—Clays are only used to make brick and the Columbia loam is at present the only thing used.

*Martin*—A brick plant, owned by Mr. J. G. Walters, has been in operation here since 1895. The surface loam is used down to 3½ feet. The clay goes directly from the pit to a Monarch soft mud machine, with a daily capacity of 20,000. The brick are then dried for 1 week in outdoor racks, holding 250,000, and then put in kilns to be dried out and burnt. There are three updraft (Dutch) kilns, two holding 250,000 each, and one holding 300,000. They are dried out with wood and coke for 4 or 5 days, and then burned with coal for 1 week. The brick are shipped around in a radius of 50 miles. Only soft mud red brick are made.

# INDEX

Figures in italics indicate principal reference.

| <i>—A—</i>                         | Page                    |                                     | Page       |
|------------------------------------|-------------------------|-------------------------------------|------------|
| Alamo .....                        | 7                       | Brickyards at Middleton .....       | 77         |
| Alberton .....                     | 81                      | Brickyards at Milan .....           | 69         |
| Allen pit .....                    | 106                     | Brickyards at Obion .....           | 108        |
| Alluvium .....                     | 8                       | Brickyards at Paris .....           | 91         |
| Alluvial region .....              | 4                       | Brickyards at Puryear .....         | 92         |
| Analyses .....                     | 26, 89, 90, 94, 97, 100 | Brickyards at Ripley .....          | 98         |
| Asylum, Bolivar .....              | 74                      | Brickyards at Rives .....           | 108        |
| Auger machine .....                | 34                      | Brickyards at Scott's Hill .....    | 82         |
| <i>—B—</i>                         |                         | Brickyards at Trenton .....         | 72         |
| Ball clay .....                    | 14, 19, 38, 89, 94      | Brickyards at Trezevant .....       | 52         |
| Barnhart, Bill .....               | 44                      | Brickyards at Union City .....      | 109        |
| Barrett, J. W. ....                | 72                      | Brickyards at Whiteville .....      | 79         |
| Baxter Hill .....                  | 55                      | Brizentine land .....               | 83         |
| Benton County .....                | 9, 11, 40               | Brownsville .....                   | 8, 38, 80  |
| Big Cut .....                      | 12                      | Burning .....                       | 35         |
| Blue Cut .....                     | 11                      | Burning cost .....                  | 35, 36     |
| Bolivar .....                      | 8, 27, 38, 74           | <i>—C—</i>                          |            |
| Bolivar Asylum .....               | 74                      | Camden .....                        | 8          |
| Bolivar Brick & Tile Company ..... | 74                      | Camden chert .....                  | 58         |
| Bowden Farm .....                  | 83                      | Capleville .....                    | 109        |
| Brackish water deposits .....      | 24                      | Carboniferous .....                 | 8          |
| Bransford & Sons .....             | 109                     | Carner, R. H. ....                  | 58         |
| Breedlove place .....              | 87                      | Carroll County....                  |            |
| Brick clay .....                   | 30                      | .....11, 14, 15, 23, 25, 29, 30, 40 |            |
| Brick labor .....                  | 37                      | Chandler, Mrs. Polly .....          | 46         |
| Brick molders .....                | 37                      | Character of deposits .....         | 22         |
| Brick output, 1910 .....           | 38                      | Chase type .....                    | 63, 77     |
| Brick selling price .....          | 39                      | Chaser Mills .....                  | 33         |
| Brick setters .....                | 37                      | Chemical Analyses....               |            |
| Brick wheelers .....               | 37                      | .....26, 89, 90, 94, 97, 100        |            |
| Brickyards at Bolivar .....        | 74                      | Chester County .....                | 11, 14, 56 |
| Brickyards at Brownsville .....    | 80                      | China ware .....                    | 22         |
| Brickyards at Cottage Grove .....  | 84                      | Cities and towns .....              | 7, 8       |
| Brickyards at Covington .....      | 111                     | Clay, ball .....                    | 39, 89, 94 |
| Brickyards at Dyersburg .....      | 59                      | Clay, character of deposits .....   | 22         |
| Brickyards at Gilmore .....        | 100                     | Clay, color of .....                | 28, 29, 30 |
| Brickyards at Humboldt .....       | 66                      | Clay, definition .....              | 18, 19, 20 |
| Brickyards at Jackson .....        | 101                     | Clay, deposits of .....             | 41         |
| Brickyards at Lexington .....      | 81                      | Clay, drainage tile .....           | 20         |
| Brickyards at Martin .....         | 112                     | Clay, fusibility of .....           | 28, 29, 30 |
| Brickyards at McKenzie .....       | 50                      | Clay, fire .....                    | 39         |
| Brickyards at Memphis .....        | 110                     | Clay, manufacture of .....          | 35, 36, 37 |
|                                    |                         | Clay, mining of .....               | 30         |

|                                          | Page       |                                        | Page                |
|------------------------------------------|------------|----------------------------------------|---------------------|
| Clay, miscellaneous .....                | 39         | Dip .....                              | 10, 13, 14, 15      |
| Clay output for 1909 .....               | 39         | Disturbances .....                     | 5                   |
| Clay preparation .....31, 32, 33, 34, 35 |            | Dixie fireproof brick .....            | 92                  |
| Clay resources by counties .....         | 40         | Downdraft kilns .....                  | 37, 38              |
| Clay, sagger .....                       | 19, 39     | Drainage tile clay .....               | 20                  |
| Clay, shrinkage of .....                 | 28, 29, 30 | Drainage .....                         | 6                   |
| Clay, selling prices of .....            | 39         | Dresden .....                          | 8                   |
| Clay, stoneware .....                    | 22, 39     | Drying .....                           | 35                  |
| Clay, Wad .....                          | 19, 39     | Dry pan .....                          | 31                  |
| Cleaver, Jim .....                       | 46         | Dry press .....                        | 34                  |
| Coffee Bluff .....                       | 9          | Dyer County .....                      | 58                  |
| Columbia formation ....8, 14, 17, 27, 28 |            | Dyersburg .....                        | 7, 8, 38, 59        |
| Common brick .....                       | 20         | Durden Sand Company .....              | 77                  |
| Continuous kilns .....                   | 37         |                                        |                     |
| Conveyors .....                          | 31         | —E—                                    |                     |
| Cooper, H. M. ....                       | 47         | Earthquakes .....                      | 4, 5, 6             |
| Corduroying roads .....                  | 7          | Eckel ..                               | 1                   |
| Cosley Clay Company .....                | 93         | Electrical ware .....                  | 22                  |
| Costen-Moore & Company .....             | 50         | Embayment clays .....                  | 22                  |
| Cost of burning .....35, 36, 37, 38      |            | Eocene series .....                    | 5, 8, 13            |
| Cottage Grove .....                      | 32, 38, 88 | Eutaw sands .....                      | 3, 8, 9, 10, 24, 25 |
| Covington .....                          | 8, 38, 111 |                                        |                     |
| Crawford farm .....                      | 91         | —F—                                    |                     |
| Cretaceous .....                         | 8, 9       | Falkner, J. B., pit .....              | 45                  |
| Creswell, J. M. ....                     | 69         | Fayette County .....                   | 24, 29, 30, 50      |
| Crider .....                             | 1          | Ferguson, Mr. ....                     | 77                  |
| Crockett County .....                    | 24, 57     | Fertilizers .....                      | 6                   |
| Crops .....                              | 6          | Fire brick .....                       | 21                  |
| Cross, R. D. ....                        | 74         | Fire clay .....                        | 39                  |
| Cubbins Brick Company .....              | 110        | Fire clay pit .....                    | 52                  |
| Currier pits and pottery .....           | 91         | Flatwoods .....                        | 4, 5                |
| Curve .....                              | 18         | Floodplain clays .....                 | 25                  |
| Cypress Station .....                    | 3, 11      | Follis, W. T. ....                     | 62, 76              |
|                                          |            | Forked Deer .....                      | 3, 19, 25           |
| —D—                                      |            | Formations described .....             | 8                   |
| Dale .....                               | 61         | Fossils .....                          | 11, 15, 16, 44, 63  |
| Davis pit .....                          | 105        | Fox Tile Company .....                 | 108                 |
| Davenport pit, Jim .....                 | 61         | Fresh water deposits .....             | 23                  |
| Decatur County .....                     | 9, 29      | Friendship .....                       | 7                   |
| Definition of ball clay .....            | 19         | Fusibility .....                       | 28, 29, 30          |
| Definition of common brick .....         | 20         |                                        |                     |
| Definition of drainage tile clay .....   | 20         | —G—                                    |                     |
| Definition of fire brick .....           | 21         | Gatlin, Mr. ....                       | 91                  |
| Definition of kaolin .....               | 18         | General development .....              | 6                   |
| Definition of potters clay .....         | 19         | General distribution of deposits ..... | 27                  |
| Definition of sagger's clay .....        | 19         | Geology of area .....                  | 8                   |
| Definition of wad .....                  | 19         | Geology of Carroll County .....        | 41                  |
| Deposits, character of .....             | 22, 23     | Geology of Chester County .....        | 56                  |
| Development, general .....               | 6          | Geology of Crockett County .....       | 57                  |
|                                          |            | Geology of Decatur County .....        | 58                  |

|                                               | Page                  |                                  | Page                      |
|-----------------------------------------------|-----------------------|----------------------------------|---------------------------|
| Geology of Dyer County .....                  | 59                    | India .....                      | 25, 27, 89                |
| Geology of Fayette County .....               | 61                    | Introduction .....               | 1                         |
| Geology of Gibson County .....                | 65                    | Iron pits .....                  | 76                        |
| Geology of Hardeman County .....              | 74                    |                                  |                           |
| Geology of Hardin County .....                | 80                    | —J—                              |                           |
| Geology of Haywood County .....               | 80                    | Jackson .....                    | 3, 7, 16, 38, 101         |
| Geology of Henderson County .....             | 81                    | Jackson Mine .....               | 97                        |
| Geology of Henry County .....                 | 83                    | Johnson-Porter Clay Company..... | 85                        |
| Geology of Lake County .....                  | 97                    |                                  |                           |
| Geology of Lauderdale County .....            | 99                    | —K—                              |                           |
| Geology of Madison County .....               | 99                    | Kansas City, Memphis &           |                           |
| Geology of McNairy County .....               | 106                   | Birmingham .....                 | 6, 7                      |
| Geology of Obion County .....                 | 107                   | Kaolin .....                     | 18                        |
| Geology of Shelby County .....                | 109                   | Keller, R. B. ....               | 77                        |
| Geology of Tipton County .....                | 111                   | Kentucky-Tennessee line ..       | 5                         |
| Geology of Weakley County .....               | 112                   | Kilns, continuous .....          | 37                        |
| Gibson County .....                           | 7, 24, 29, 30, 64     | Kilns, downdraft .....           | 37                        |
| Gilmore .....                                 | 1, 27, 38, 100        | Kilns, Dutch .....               | 36                        |
| Glacial clays .....                           | 24                    | Kilns, Scove .....               | 36                        |
| Glenn, L. C. ....                             | 12                    |                                  |                           |
| Gooch and Harris .....                        | 107                   | —L—                              |                           |
| Gravel Hill .....                             | 11                    | Labor of making brick .....      | 37                        |
| Grinding .....                                | 31                    | Lafayette .....                  | 8, 14, 16, 17, 23, 27, 28 |
| Guy .....                                     | 11                    | LaGrange .....                   | 3, 15, 61                 |
|                                               |                       | LaGrange sand ..                 | 16, 24, 26, 3, 8, 14, 27  |
| —H—                                           |                       | Lake County .....                | 97                        |
| Hancock pits .....                            | 62                    | Lauderdale County .....          | 98                        |
| Hardin County .....                           | 9, 79                 | Lexington .....                  | 8, 10, 11, 12, 38, 81     |
| Hardin farm .....                             | 91                    | Lignitic material .....          | 15                        |
| Hatchie River .....                           | 3, 18, 25             | Lithological character ..        | 9, 11, 13, 14, 17         |
| Haywood County .....                          | 80                    | Lightfoot, F. H. ....            | 64                        |
| Hardeman County ....                          |                       | Livermore Foundry .....          | 64                        |
| .....3, 11, 14, 15, 23, 29, 39                |                       | Loam .....                       | 18                        |
| Henderson County ..                           | 8, 10, 11, 14, 29, 81 | Loess .....                      | 17, 25                    |
| Henry .....                                   | 27, 84                | Long, J. B. ....                 | 101                       |
| Henry Clay Company ....                       | 16, 18, 82, 87        | Louisville and Nashville .....   | 6, 7                      |
| Henry County ....                             |                       | Lovin, L. L. ....                | 59                        |
| .....3, 7, 11, 14, 15, 23, 25, 29, 30, 38, 82 |                       | Lyons Brick Company .....        | 111                       |
| Hico .....                                    | 24, 27, 41            |                                  |                           |
| Hickory Valley .....                          | 76                    | —M—                              |                           |
| Hills of erosion .....                        | 3, 5                  | Machine-repress .....            | 35                        |
| Hollow Rock .....                             | 23, 25, 27, 44        | Madison County ..                | 7, 14, 15, 23, 29, 30, 39 |
| Hollowleaf-Trezavant road .....               | 52                    | Malesus .....                    | 103                       |
| Humboldt .....                                | 7, 8, 27, 38, 66      | Mandle-Sant Clay Company....     |                           |
| Huntingdon .....                              | 8, 47                 | .....17, 27, 89, 92, 96          |                           |
|                                               |                       | Mann pit .....                   | 85                        |
| —I—                                           |                       | Marine deposits .....            | 24                        |
| Ichthyosaurus .....                           | 11                    | Martin .....                     | 8, 38, 112                |
| Illinois Central .....                        | 6, 16                 |                                  |                           |

|                                  | Page                         |                                          | Page                         |
|----------------------------------|------------------------------|------------------------------------------|------------------------------|
| McCabe & Company .....           | 98                           | Origin of topography .....               | 4                            |
| McClanahan, B. F. ....           | 82                           | Output of stoneware, 1909 .....          | 39                           |
| McElrath, Thos. H. ....          | 92                           |                                          |                              |
| McKenzie .....                   | 8, 24, 38, 49, 88            | —P—                                      |                              |
| McKnight Brothers .....          | 66, 80                       | Palestine pit ....                       | 88                           |
| McLemoresville .....             | 56                           | Paleozoic rocks .....                    | 8, 15                        |
| McNanee .....                    | 61                           | Pan-drying .....                         | 31                           |
| McNairy County .....             | 3, 11, 12, 106               | Paris .....                              | 3, 7, 13, 17, 23, 24, 38, 91 |
| McNeal Springs .....             | 76                           | Parnell, Ed .....                        | 55                           |
| Medon .....                      | 103                          | Parsons .....                            | 9                            |
| Memphis .....                    | 4, 6, 7, 13, 14, 15, 38, 110 | Pate, Andy .....                         | 52                           |
| Memphis Stone and Gravel Company | 58                           | Perryville .....                         | 58                           |
| Middleburg .....                 | 77                           | Physical tests .....                     | 28, 29, 30                   |
| Middleton .....                  | 38, 77                       | Piney creek .....                        | 12                           |
| Milan .....                      | 3, 8, 21, 27, 38, 69         | Pinson .....                             | 24, 27, 104                  |
| Mills, chaser .....              | 33                           | Pinson Pottery Company .....             | 104                          |
| Mills, pug .....                 | 32                           | Pipkin, Joe .....                        | 77                           |
| Mining of clay .....             | 30                           | Pleistocene .....                        | 8, 17                        |
| Mississippi River .....          | 10, 17, 18, 24               | Pliocene .....                           | 8, 16, 23                    |
| Mississippian series .....       | 9                            | Polk, Mrs. Octavia .....                 | 76                           |
| Mixtures of clays .....          | 22                           | Porcelain .....                          | 22                           |
| Mobile and Ohio .....            | 6                            | Porter's Creek Formation....             |                              |
| Monroe wad mine .....            | 96                           | .....4, 58, 13, 24, 26                   |                              |
| Moore, A. M. ....                | 79                           | Potteries .....                          | 39, 49, 77, 91, 104, 109     |
| Moscow .....                     | 27, 63                       | Pottery pits .....                       | 24, 91                       |
| Mud, stiff .....                 | 34                           | Potter's clay .....                      | 19, 30                       |
| Mud temperers .....              | 37                           | Press, dry .....                         | 34                           |
| Mud wheelers .....               | 37                           | Price of lands .....                     | 6                            |
|                                  |                              | Pug mill .....                           | 32                           |
| —N—                              |                              | Purveyor .....                           | 16, 92                       |
| Nashville .....                  | 27                           |                                          |                              |
| Nashville, Chattanooga and St.   |                              | —Q—                                      |                              |
| Louis .....                      | 6, 7, 9                      | Quaternary system .....                  | 17                           |
| Nashville Pottery pit .....      | 87                           |                                          |                              |
| Newbill Crossroads .....         | 55                           | —R—                                      |                              |
| New Boston .....                 | 91                           | Rackers .....                            | 37                           |
| New Madrid earthquake .....      | 4, 5, 6                      | Railroads and towns....                  |                              |
| Nichols, J. M. ....              | 59                           | .....40, 56, 57, 58, 60, 64, 65, 73, 79, |                              |
| Nonconnah Pottery Company .....  | 109                          | 80, 81, 83, 97, 98, 99, 109, 111, 112    |                              |
| Novaculite .....                 | 7, 16, 58                    | Railway facilities .....                 | 6, 7                         |
|                                  |                              | Reelfoot Lake .....                      | 4                            |
| —O—                              |                              | Repressing .....                         | 35                           |
| Obion .....                      | 28, 38, 108                  | Repress machine .....                    | 35                           |
| Obion County .....               | 107                          | Residual ridge .....                     | 3                            |
| Obion River .....                | 3, 18, 25                    | Reynoldsburg .....                       | 13                           |
| Offbearers .....                 | 37                           | Richard, Robt. ....                      | 79                           |
| Orange sands .....               | 16                           | Ries, .....                              | 1, 20                        |
|                                  |                              | Ripley sands .....                       | 3, 8, 11, 12, 23, 25, 27     |
|                                  |                              | Ripley .....                             | 8, 38, 98                    |

|                                       | Page                         |                                     | Page               |
|---------------------------------------|------------------------------|-------------------------------------|--------------------|
| Rives .....                           | 38                           | Tennessee-Mississippi Divide....    | 2, 3, 82           |
| Rives Tile Company .....              | 108                          | Tennessee River .....               | 3, 9               |
| Roads, character of .....             | 7                            | Tennessee Brick & Tile Company...   | 59                 |
| Rogers Spring .....                   | 77                           | Tennessee Ball & Sagger Clay        |                    |
| Routon .....                          | 97                           | Company .....                       | 93, 94             |
| —S—                                   |                              | Tennessee Brick Company .....       | 110                |
| Safford .....                         | 16                           | Terrace clays .....                 | 25                 |
| Sagger clay .....                     | 19, 39                       | Tertiary System .....               | 10, 11, 13, 14, 15 |
| Sanitary ware .....                   | 22                           | Thomas, Mrs. W. A. ....             | 41                 |
| Sands at Hollow Rock .....            | 47                           | Tile plant .....                    | 28, 108            |
| Sand .....                            | 17                           | Tiptonville .....                   | 6                  |
| Sasser, J. D., Sr. ....               | 77                           | Tipton County .....                 | 111                |
| Saulsbury .....                       | 77                           | Toone .....                         | 24, 27, 77         |
| Scott's Hill .....                    | 10, 38, 92                   | Topography of West Tennessee ....   | 2                  |
| Scove kilns .....                     | 36                           | Topograaphy of Carroll County....   | 40                 |
| Screens .....                         | 31                           | Topography of Chester County ....   | 56                 |
| Sections....                          |                              | Topography of Crockett County ...   | 57                 |
| ...9, 10, 11, 12, 13, 15, 16, 17, 41, |                              | Topography of Decatur County ....   | 57                 |
| 43, 44, 46, 47, 52, 54, 56, 61, 62,   |                              | Topography of Dyer County .....     | 58                 |
| 63, 70, 71, 75, 76, 84, 85, 86, 87,   |                              | Topography of Fayette County ....   | 60                 |
| 88, 89, 90, 92, 93, 100, 102, 103,    |                              | Topography of Gibson County .....   | 64                 |
| 104, 105, 106                         |                              | Topography of Hardeman County...72  |                    |
| Seger furnaces .....                  | 1                            | Topography of Hardin County .....   | 79                 |
| Selling price, brick and clay .....   | 39                           | Topography of Haywood County ..     | 80                 |
| Selling price, stoneware, 1909 .....  | 39                           | Topography of Henderson County..    | 81                 |
| Selma clays .....                     | 3, 8, 10, 11, 24, 25         | Topography of Henry County .....    | 82                 |
| Selmer .....                          | 8, 107                       | Topography of Lake County .....     | 97                 |
| Shady Hill .....                      | 11, 12                       | Topography of Lauderdale County..   | 98                 |
| Shelby County .....                   | 7, 109                       | Topography of Madison County ...    | 99                 |
| Shelton, R. B. ....                   | 111                          | Topography of McNairy County ...106 |                    |
| Shrinkage .....                       | 28, 29, 30                   | Topography of Obion County .....    | 107                |
| Silurian age .....                    | 9                            | Topography of Shelby County .....   | 109                |
| Sloan, O. C. ....                     | 52                           | Topography of Tipton County .....   | 111                |
| Soaking pits .....                    | 32                           | Topography of Weakley County ...112 |                    |
| Soapstone .....                       | 13                           | Towns and cities .....              | 7, 9, 40           |
| Somerville .....                      | 8, 64                        | Trenton .....                       | 8, 38, 72          |
| Southern Brick & Tile Company ...100  |                              | Trezevant .....                     | 27, 38, 52         |
| South Memphis Brick Company ...110    |                              | Turner, Vaughan, Taylor & Co. ....  | 32                 |
| Southern Railway .....                | 6                            | Turning .....                       | 35                 |
| Sparks, C. ....                       | 49, 88                       | —U—                                 |                    |
| Stevens, W. B. ....                   | 109                          | Union City .....                    | 7, 28, 38, 108     |
| Stiff mud .....                       | 34                           | Union City Tile Company .....       | 108                |
| Stone ware....                        | 22, 39, 49, 77, 91, 104, 109 | —V—                                 |                    |
| Stratigraphy .....                    | 8                            | Vale .....                          | 97                 |
| Stratigraphic positions of deposits.. | 25                           | —W—                                 |                    |
| Strop, J. C. ....                     | 87, 88                       | Wad .....                           | 19, 39, 96         |
| —T—                                   |                              | Walters, J. B. ....                 | 112                |
| Teachout, Mrs. E. B. ....             | 45                           |                                     |                    |
| Tempering .....                       | 32                           |                                     |                    |

|                          | Page        |                                   | Page       |
|--------------------------|-------------|-----------------------------------|------------|
| Watkins, Wm. ....        | 54          | White, J. C. ....                 | 81, 84     |
| Weakley County ....      | 24, 39, 112 | Whitlock ....                     | 27, 93, 97 |
| Well, Bolivar ....       | 76          | Whitfield, S. C. ....             | 103        |
| Well, Humboldt ....      | 66          | Whipple, R. M. ....               | 108        |
| Well, Huntingdon ....    | 48          |                                   |            |
| Well, McKenzie ....      | 51          | —Y—                               |            |
| Well, Milan ....         | 69          |                                   |            |
| Wet pan ....             | 32          | Yazoo and Mississippi Valley .... | 6, 7       |
| Wheeler, Mrs. R. R. .... | 64          |                                   |            |
| Whiteville ....          | 38, 79      | —Z—                               |            |
| White ware ....          | 22          |                                   |            |
|                          |             | Zieme, Carl H. ....               | 89, 94     |

